ANALYSIS OF THE CATTLE PRODUCTION CYCLE AND FACTORS RELATING TO IT

by

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INTRODUCTION

Purpose

Cyclic movements in production and prices of many agricultural products are considered to be an indication of imperfect functioning of the market over given periods of time. These cycles may appear as the result of faulty or unsound forecasting of future prices by producers and as a result of factors affecting these prices. Forecasting cattle production and prices is difficult because it is affected by unpredictable elements such as weather conditions, size of corn crops, and fluctuations in general business conditions. Any factor which affects the demand or supply of a product will indirectly influence price, and hence, the production of that commodity under a relatively free economy.

The general aim of this thesis was (1) to compile and correlate data relating to the cattle production cycle, to isolate the causes and effects of the cycle, and to study the inter-relationship of production and price cycles influenced by demand and supply and reflected in price; and (2) to see whether the production cycle or factors relating to it could be used in predicting future trends in the beef cattle industry which would be of value to livestock producers in formulating their production programs.

Scope

An analysis of events taking place during the various phases of the production cycles was used in determining the factors related to the cycle. Included in the scope of the study were trends in cattle numbers and beef production, numbers of cattle per capita of human population, comparison of the cycles as to length, amplitude, and rate of change in numbers; and the inter-relationship of demand, supply, and price.

Beef cattle production has passed through four definite cycles since 1890. Whenever possible all four cycles were considered; however, comparable figures applicable to slaughtering and price constituents were often obtainable for only one or two cycles or portions of various phases of the cycles. Results obtained from such data were not always applicable to all the cycles.

Limitations

Considerable material has been written concerning price and production cycles in general, but little work has been done which refers directly to beef cattle cycles. Limitations in analysis resulted from the difficulty in obtaining comparable data in comparisons covering the same periods of time; in the necessity of using some data in analysis which at best were but good estimates of actual happenings; and from the fact that data concerning the subject were limited to one or two cycles which made generalized statements for all cycles impossible.

Many factors affecting price and production such as weather conditions, practices and policies of cattle producers, and changes in consumer demand are not readily measurable. Only those factors for which measurable data were available could be evaluated with a degree of accuracy.

Much of the material on the slaughter of various classes of cattle dates back to The Packers and Stockyards Act of 1921. From that time on the government collected and published information on the classes of livestock slaughtered in federally-inspected plants. As this period covers only one complete cycle, conclusions based upon facts contained therein cannot be applied without reservations to all four cycles.

Methods of Procedure

The fundamental methods followed in the development of this study were deductions from graphical presentations of factors related to the cattle production cycles and comparisons of these factors by means of multiple correlations to determine if their relationships were significant.

Many of the data pertaining to factors which seemed to be related had to be calculated from other basic data before they could be placed on a comparable basis.

Long time trend lines were used as a measure of the overall picture regarding increases and decreases in cattle numbers, beef production, and slaughter.

REVIEW OF LITERATURE

Factors Responsible for the Cyclic Movement of Cattle Production

Most economists believe that the underlying causes of the beef production and price cycles are inherent in the cattle industry and may be credited to the tendency of producers to respond to present prices. John A. Hopkins, in his statistical study of the prices and production of beef cattle, contends that these cyclical movements of cattle prices cannot be explained by the tendency first to over-produce cattle for a period of eight or nine years and second, to under-produce for a similar period. He maintains that the cattle cycles result from alienable forces outside the industry. His views may be summarized by his following statements:[1]

> .... Granting that adjusting cattle production requires a long period does not establish the theory that cattle price and production cycles are to be explained by an inherent and self perpetuating tendency on the part of producers to over and under-produce.
>
> The cattle cycles of the past 60 years are apparently due to forces from outside of the cattle industry, but these forces or conditions which have caused the major crises in the cattle industry do not seem to be related to any regularly recurrent phenomena. The prices of cattle are affected, of course by the general activity or depression of

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[1]John A. Hopkins, Jr., "A Statiscal Study of the Prices and Production of Beef Cattle." Iowa Agricultural Experiment Station Research Bulletin No. 101, December, 1926, p. 351,356.

> business, and are therefore influenced by the general business cycles. This will probably account for a minor series,of cycles but not for the major cycles which have been 12 to 15 years in length. No phenomena of a regularly recurrent nature and with a periodicity of 12 or 15 years have come to light to explain the major cycles....
>
> .... The most reasonable conclusion seems to be that the short time variations are simply the responses of the market to the various eventualities such as long and short corn crops, drouths, etc., which befall the producer of cattle for short periods, to the fluctuating demand for beef, which depends to a large degree on the prosperity of the country, and to the supply of possible substitutes for beef, such as pork and mutton. The effects of these various forces on the production and price of cattle are often slow to appear and may have unexpected repercussions before they have run their course.

These statements are basically in accordance with ideas of other economists; the difference being that Hopkins concludes them to be short time variations of various forces affecting the production and prices of cattle which are slow to appear. Other economists, namely Shepherd and Thomsen recognize in the delayed reaction of these "short time variations" sufficient causes for changes in demand and supply of beef cattle and for the response of cattle producers to these changes which result in the wave-like pattern of cattle production. Hopkins does not concede these undulating patterns reflected by cattle numbers to be cycles because differences appear in length, amplitude, and duration; others feel that production cycles cannot be absolute or as "regular as clockwork," and allow for elasticity in the use of the word, cycle.

Relationship of Cattle Production to Price

The general level of prices of all commodities varies greatly over a period of time and the causes of these changes are not always known. To remove fluctuations brought about by the changes in the general price level, it is often necessary to deflate the actual value of a commodity by dividing its value by the index number of prices of all commodities to show what the probable movement of prices would have been had the general price level remained constant.

Geoffrey S. Shepherd found the above method feasible in comparing beef cattle numbers with price.[2] In his study of the relationship of the cattle production cycle to price, Shepherd found that "cyclic movements in the values of beef cattle per head at the farm cause corresponding changes in the numbers of head of beef cattle on farms--not immediately, but after a lag of several years." He also states that the concurrent inverse correlation between slaughter and the price of beef is not close for "(1) prices at the farm are affected by the demand for breeding purposes as well as by the amount of slaughter, and (2) the effects of changes in consumer demand upon beef cattle prices are only partly removed by dividing the value-per-head series through by the index of the general price level."

General business conditions also are closely associated

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[2] Geoffrey S. Shepherd, Agricultural Price Analysis, (Ames, Iowa, c.1941) p. 63.

with the general price level. Demand for beef and income from meat animals are reflected by changes in consumers' incomes. Lynn Robertson and M. Paul Mitchell of Purdue University Agricultural Experiment Station point out that:[3]

> The income from meat animals moves upward or downward as the national income moves up or down. Changes in demand may be reflected either by changes in price for the same supply or by changes in the quantity consumed or by both.

It thus seems that the price is the most important factor in marketing cattle, and that almost any difficulty in production can be overcome if the price is sufficiently high enough to offset the expense.

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[3] Lynn Robertson and M. Paul Mitchell, "Prices of Beef Cattle." Purdue University Agricultural Experiment Station Bulletin No. 445, January, 1940, p. 5

LONG TIME TRENDS IN CATTLE NUMBERS AND BEEF PRODUCTION

General Trends

For the purpose of analysis, total cattle numbers were subdivided into beef cattle numbers (which included all cattle other than milk cows) and milk cow numbers. These numbers, listed in Table 1 and graphically presented in Fig. 1, show that following the Civil War, the number of all cattle on farms increased each succeeding year from 28.6 million head in 1867 to approximately 60 million head in 1890. A long-time trend line from 1890 to the present time indicates a definite upward tendency in total cattle numbers on farms in spite of short time variations from the normal trend. Using the trend line as a basis, all cattle numbers increased from 55.5 million in 1890 to 72.1 million in 1945, an expansion of 16.6 million.

The same tendency toward rapid increase from 1867 to 1890 occurred in beef cattle numbers, and from 1890 beef cattle numbers fluctuated similar to total cattle numbers. Again using the trend line as a basis, beef cattle numbers from 1890 to 1945 made but a slight gain of approximately 3.9 million head as compared to the 12.7 million head gain of milk cow numbers. This gain in milk cow numbers has been so steady and so consistent that no trend line was required to compute it. Since the increase in milk cow numbers constitutes more than three-fourths the gain in numbers of total cattle, it is clear that the upward trend in all cattle numbers since 1890 is chiefly

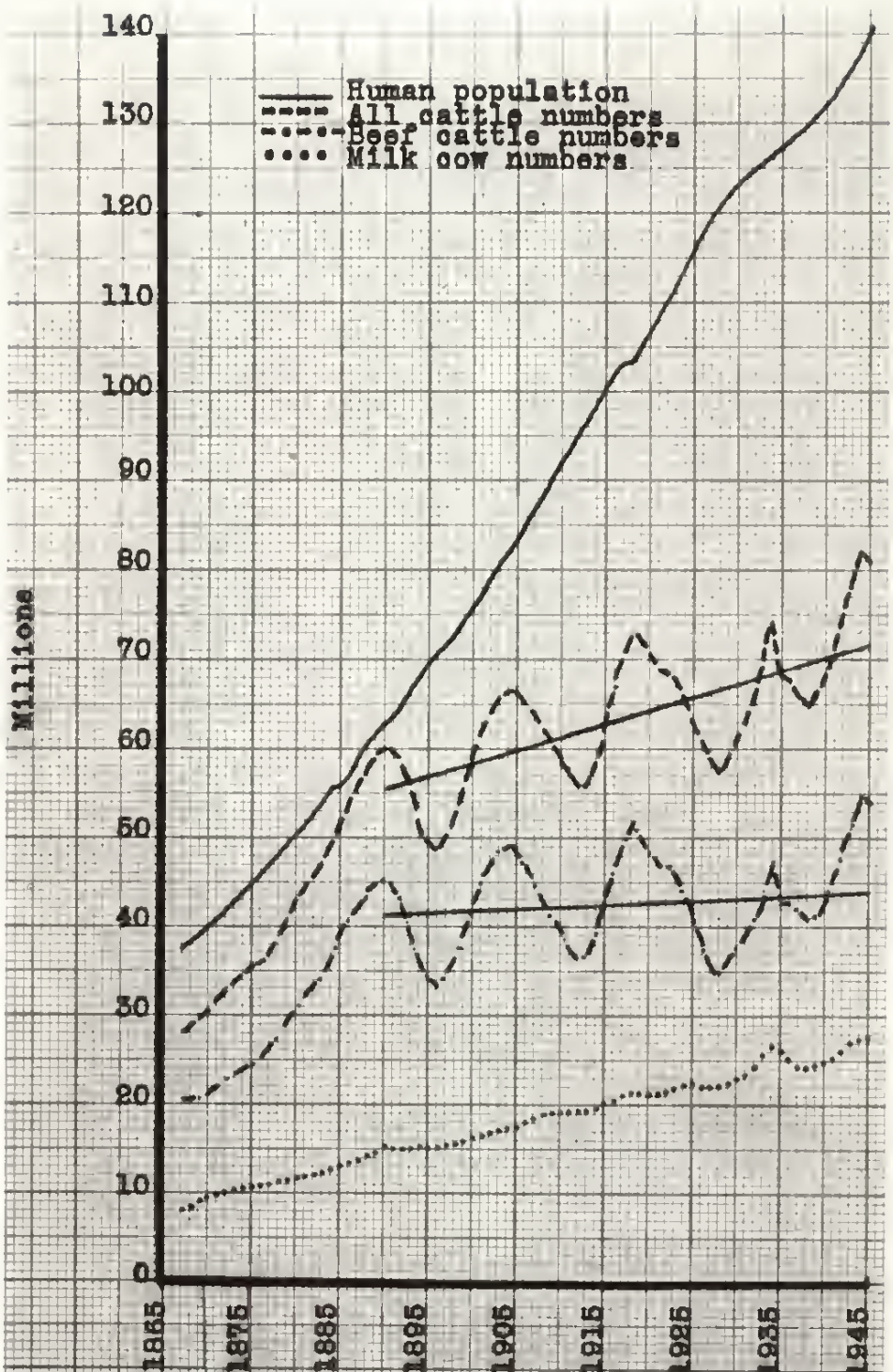

Figure 1. Trend of human population and cattle numbers on farms in the United States on January 1, 1867 to 1945.

Table 1. Number of cattle per one hundred human population in the United States from 1867 to 1945.

Year	Human Population [1]	All Cattle		Beef Cattle		Milk Cows	
		Number in Thous. [2]	Per 100 of Population [3]	Number in Thous. [2]	Per 100 of Population [3]	Number in Thous. [2]	Per 100 of Population [3]
1867	37,376	28,636	76.6	20,373	54.5	8,263	22.1
1868	38,213	29,238	76.5	20,533	53.7	8,705	22.8
1869	39,051	30,060	77.0	20,855	53.4	9,205	23.6
1870	39,905	31,082	77.9	21,410	53.7	9,672	24.2
1871	40,938	32,107	78.4	22,166	54.1	9,941	24.3
1872	41,972	33,078	78.8	22,887	54.5	10,191	24.3
1873	43,006	33,830	78.7	23,482	54.6	10,348	24.1
1874	44,040	34,821	79.1	24,259	55.1	10,562	24.0
1875	45,073	35,361	78.5	24,647	54.7	10,714	23.8
1876	46,107	36,140	78.4	25,319	54.9	10,821	23.5
1877	47,141	37,333	79.2	26,329	55.9	11,004	23.3
1878	48,174	39,396	81.8	28,174	58.5	11,222	23.3
1879	49,208	41,420	84.2	29,934	60.8	11,486	23.3
1880	50,262	43,347	86.2	31,593	62.9	11,754	23.4
1881	51,542	44,501	86.3	32,524	63.1	11,977	23.2
1882	52,821	45,738	86.6	33,504	63.4	12,234	23.2
1883	54,100	47,387	87.6	34,816	64.4	12,571	23.2
1884	55,379	49,804	89.9	36,921	66.7	12,883	23.3
1885	56,658	52,465	92.6	39,250	69.3	13,213	23.3
1886	57,938	54,868	94.7	41,390	71.4	13,478	23.3
1887	59,217	56,602	95.6	42,714	72.1	13,888	23.5
1888	60,496	58,599	96.9	44,249	73.1	14,350	23.7
1889	61,775	59,178	95.8	44,472	72.0	14,706	23.8

Table 1. continued

Year	Human Population	All Cattle		Beef Cattle		Milk Cows	
		Number in Thous.	Per 100 of Population	Number in Thous.	Per 100 of Population	Number in Thous.	Per 100 of Population
1890	63,056	60,014	95.2	45,014	71.4	15,000	23.8
1891	64,361	59,968	93.2	44,835	69.7	15,133	23.5
1892	65,666	58,126	88.5	42,949	65.4	15,177	23.1
1893	66,970	55,119	82.3	39,955	59.7	15,164	22.6
1894	68,275	51,715	75.7	36,478	53.4	15,237	22.3
1895	69,580	49,510	71.2	34,280	49.3	15,230	21.9
1896	70,885	49,205	69.4	33,939	47.9	15,266	21.5
1897	72,189	50,447	69.9	35,065	48.6	15,382	21.3
1898	73,494	52,868	71.9	37,227	50.7	15,641	21.3
1899	74,799	55,927	74.8	39,833	53.3	16,094	21.5
1900	76,094	59,739	78.5	43,195	56.8	16,544	21.7
1901	77,585	62,576	80.7	45,868	59.1	16,708	21.5
1902	79,160	64,418	81.4	47,426	59.9	16,992	21.5
1903	80,632	66,004	81.9	48,787	60.5	17,217	21.4
1904	82,165	66,442	80.9	48,957	59.6	17,485	21.3
1905	83,820	66,111	78.9	48,288	57.6	17,823	21.3
1906	85,457	65,009	76.1	46,779	54.8	18,230	21.3
1907	87,000	63,754	73.3	45,125	51.9	18,629	21.4
1908	88,709	61,989	69.9	42,997	48.5	18,992	21.4
1909	90,492	60,774	67.2	41,573	45.9	19,201	21.2

Table 1. continued.

Year	Human Population	All Cattle		Beef Cattle		Milk Cows	
		Number in Thous.	Per 100 of Population	Number in Thous.	Per 100 of Population	Number in Thous.	Per 100 of Population
1910	92,407	58,993	63.8	39,543	42.8	19,450	21.0
1911	93,868	57,225	61.0	37,803	40.3	19,422	20.7
1912	95,331	55,675	58.4	36,158	37.9	19,517	20.5
1913	97,227	56,592	58.2	37,012	38.1	19,580	20.1
1914	99,118	59,461	60.0	39,640	40.0	19,821	20.0
1915	100,549	63,849	63.5	43,579	43.3	20,270	20.2
1916	101,966	67,438	66.1	46,686	45.8	20,752	20.4
1917	103,266	70,979	68.7	49,767	48.2	21,212	20.5
1918	103,203	73,040	70.8	51,504	49.9	21,536	20.9
1919	104,512	72,094	69.0	50,549	48.4	21,545	20.6
1920	106,466	70,400	66.1	48,945	46.0	21,455	20.2
1921	108,541	68,714	63.3	47,258	43.5	21,456	19.8
1922	110,055	68,795	62.5	46,944	42.7	21,851	19.9
1923	111,950	67,546	60.3	45,408	40.6	22,138	19.8
1924	114,113	65,996	57.8	43,665	38.3	22,331	19.6
1925	115,832	63,373	54.7	40,798	35.2	22,575	19.5
1926	117,399	60,576	51.6	38,166	32.5	22,410	19.1
1927	119,038	58,178	48.9	35,927	30.2	22,251	18.7
1928	120,501	57,322	47.6	35,091	29.1	22,231	18.4
1929	121,770	58,877	48.4	36,437	29.9	22,440	18.4

Table 1. continued.

Year	Human Population	All Cattle		Beef Cattle		Milk Cows	
		Number in Thous.	Per 100 of Population	Number in Thous.	Per 100 of Population	Number in Thous.	Per 100 of Population
1930	123,077	61,003	49.6	37,971	30.9	23,032	18.7
1931	124,040	63,030	50.8	39,210	31.6	23,820	19.2
1932	124,840	65,801	52.7	40,905	32.8	24,896	19.9
1933	125,579	70,280	56.0	44,344	35.3	25,936	20.7
1934	126,374	74,369	58.8	47,438	37.5	26,931	21.3
1935	127,250	68,846	54.1	42,764	33.6	26,082	20.5
1936	128,053	67,847	53.0	42,651	33.3	25,196	19.7
1937	128,825	66,098	51.3	41,449	32.2	24,649	19.1
1938	129,825	65,249	50.3	40,783	31.4	24,466	18.8
1939	130,880	66,029	50.5	41,429	31.7	24,600	18.8
1940	131,970	68,197	51.7	43,271	32.8	24,926	18.9
1941	133,203	71,461	53.6	45,983	34.5	25,478	19.1
1942	134,665	74,162	55.8	48,764	36.2	26,398	19.6
1943	136,497	79,114	58.0	52,008	38.1	27,106	19.9
1944/4	138,101	82,364	59.6	54,708	39.6	27,656	20.0
1945/4	140,469	81,760	58.2	55,976	38.4	27,785	19.8

/1 Statistical Abstract of the United States 1944-1945, p. 8.
/2 1946 Agricultural Outlook Charts, p. 78.
/3 Data calculated.
/4 1944-1945 numbers preliminary estimates.

the result of the constant increase in dairy cattle numbers.

Although beef cattle have made little if any gain in numbers since 1900, beef production has made a rather subatantial increase. With the trend line as reference, beef and veal production increased approximately 36 per cent from 1900 to 1944, while a trend line for beef cattle during the same period indicates a slight decrease in beef cattle numbers. (Fig. 2, Table 2) It must be pointed out that dairy cattle as well as beef cattle contribute to the total beef and veal production. A large proportion of calves produced in dairy sections is sold as veal and older dairy stock is sold as beef.[4]

It would seem without further analysis that a discrepancy exists in the trend line of beef cattle numbers in Fig. 2 as compared with that in Fig. 1; however, the trough between 1890 and 1900 in Fig. 1 has the tendency to lower the trend line at the beginning of the period so that a slight increase in numbers is noted for the longer period. The trend line computed from 1900 to 1944 in Fig. 2 with the absence of this trough shows that a decrease in cattle numbers exists for the shorter period.

There were 43.2 million head of beef cattle on farms, January 1, 1900, and that year the beef and veal production was six billion pounds. In 1939 with only 41.4 million beef cattle on farms, eight billion pounds of beef and veal was

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[4]Austin A. Dowell and Knute Bjorka, Livestock Marketing (New York, c.1941) p. 76.

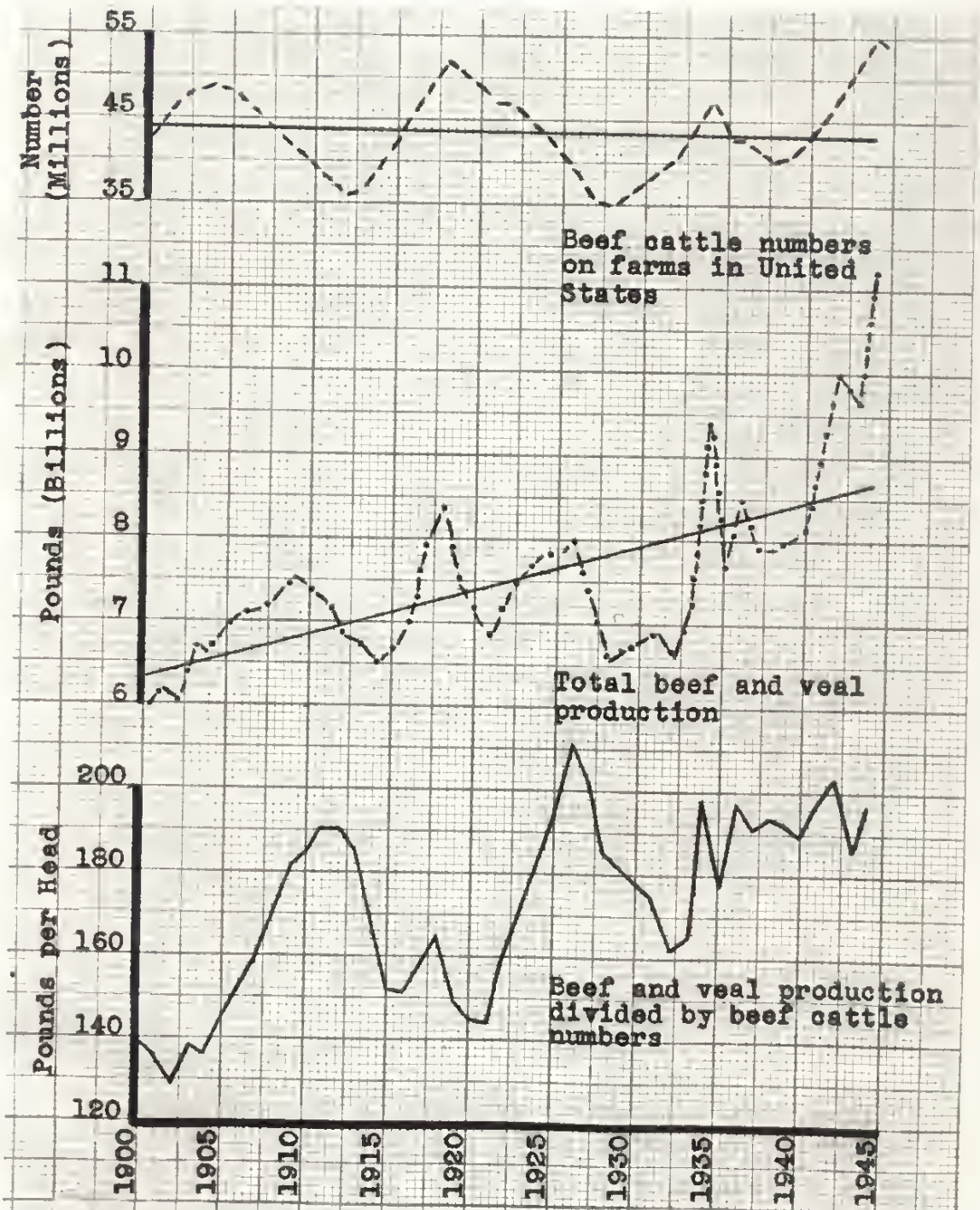

Figure 2. Total beef and veal production, beef cattle numbers, and average beef and veal production per head of beef cattle on farms.

Table 2. Total beef and veal production, beef cattle numbers on farms, January 1, and average beef and veal production per head, 1900 to 1944.

Year	Total Beef and Veal Production [1]	Beef Cattle Numbers [2]	Column 1 ÷ Column 2	Year	Total Beef and Veal Production [1]	Beef Cattle Numbers [2]	Column 1 ÷ Column 2
	Millions (pounds)	Thous.	Pounds Per Head		Millions (pounds)	Thous.	Pounds Per Head
1900	6,025	43,195	139	1923	7,637	45,408	168
1901	6,236	45,868	136	1924	7,849	43,665	180
1902	6,125	47,426	129	1925	7,867	40,798	193
1903	6,732	48,787	138	1926	8,044	38,166	211
1904	6,667	48,957	136	1927	7,262	35,927	202
1905	7,060	48,288	146	1928	6,544	35,091	186
1906	7,135	46,779	153	1929	6,632	36,437	182
1907	7,170	45,125	159	1930	6,709	37,971	177
1908	7,299	42,997	170	1931	6,832	39,210	174
1909	7,575	41,573	182	1932	6,611	40,905	162
1910	7,314	39,543	185	1933	7,331	44,344	165
1911	7,215	37,803	191	1934	9,485	47,438	200
1912	6,896	36,158	191	1935	7,627	42,764	178
1913	6,790	37,012	183	1936	8,433	42,651	198
1914	6,586	39,640	166	1937	7,906	41,449	191
1915	6,665	43,579	153	1938	7,902	40,783	194
1916	7,115	46,686	152	1939	8,002	41,429	193
1917	7,983	49,767	160	1940	8,160	43,271	189
1918	8,486	51,504	165	1941	9,121	45,983	198
1919	7,575	50,549	150	1942	9,970	48,764	204
1920	7,148	48,945	146	1943	9,683	52,006	186
1921	6,842	47,258	145	1944	10,732	54,708	196
1922	7,440	46,944	158				

[1] Livestock, Meats, and Wool Market Statistics and Related Data, 1944, p. 70.
[2] 1946 Agricultural Outlook Charts, p. 78.

produced; consequently, it seems that the country is now producing more beef and veal from the same number of cattle. (Table 2) As further evidence that more beef and veal is being produced without an increase in cattle numbers is illustrated graphically in Fig. 2 which shows a definite increase in the average beef production per head on farms from 1900 to 1944.

Several factors contribute to this apparent increase in beef and veal production without a similar change in beef cattle numbers. Calf slaughter increased sharply from 1918 to 1921 and has continued to increase until at the present time, calf slaughter represents more than one-third of the total federally inspected cattle and calf slaughter.[5] As most of the calves slaughtered outside the corn belt area come from dairy herds, part of the increase in veal production must be credited to dairy cattle. The effect of beef produced from dairy cattle is negligible as older dairy stock set aside for slaughter represents but a small fraction of total slaughter.

Better management and herd practices in the beef cattle industry have reduced losses of both calves and older stock. Edward N. Wentworth and Rudolf A. Clemen state there has been a decided increase in the number of births per thousand cattle in the United States since 1907.[6] There has been a movement toward the production of mature cattle ready for market

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[5] Dowell and Bjorka, op. cit., p. 76

[6] E. N. Wentworth and R. A. Clemen, "Increasing Productivity of American Livestock Herds." Monthly Letter to Animal Husbandmen, (Armour's Livestock Bureau) 8(2):1-4, October, 1927.

at an earlier age than previously. As shown in Table 3 a growing proportion of beef cows has been retained in cattle herds. This same tendency also was observed from 1920 to 1925 on data covering 29 states compiled by Wentworth and Clemen.[7]

This policy of increasing the percentage of cows and heifers held in herds makes it possible to produce and market a larger number of beef animals each year. At the present time, a given number of beef cattle with a larger proportionate share of cows and heifers will produce more beef annually than the same number of beef cattle (with a smaller ratio of cows and heifers) produced when a larger percentage of steers were kept to an older age.

Long Time Relationship of Cattle Numbers to Human Population

Table 1 and Fig. 3 illustrate the ratio that has existed between cattle numbers and human population from shortly after the Civil War to the present time. In 1867 all cattle numbered 76.6 cattle for one hundred of human population and increased to 95.2 cattle in 1890, the first peak in cattle numbers. Since then, human population has increased much more rapidly than cattle numbers as confirmed by the fact that at the last peak of cattle numbers in 1944, there were only 59.6 cattle per hundred of human population, a reduction of 37.4 per cent since 1890. This decrease in the proportion of total cattle to hu-

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[7] Wentworth and Clemen, loc. cit., 7(4):3 October, 1927.

Table 3. Changes in numbers of various age and sex groups of beef cattle in the United States (1900 to 1920) /1

Groups	Estimated Numbers Jan. 1 1900 (Head)	Actual Numbers Jan. 1 1920 (Head)	Relation to Total		Increase or Decrease
			Per Cent	Per Cent	Per Cent
Calves under 1 year old	8,453,000	8,809,000	22.70	24.55	4.21
Heifers 1 year old and under 2	3,468,000	4,035,000	9.31	11.24	16.35
Cows 2 years old and over	10,821,000	12,730,000	29.07	35.47	17.65
Bulls 1 year old and over	629,000	735,000	1.69	2.05	16.85
Steers 1 year old and under 2	6,448,000	4,728,000	17.32	13.18	- 26.67
Steers 2 years old and over	7,412,000	4,847,000	19.91	13.51	- 34.61
Total beef cattle	37,231,000	35,884,000	100.00	100.00	- 3.62

/1 1921 Yearbook of Agriculture, p. 317

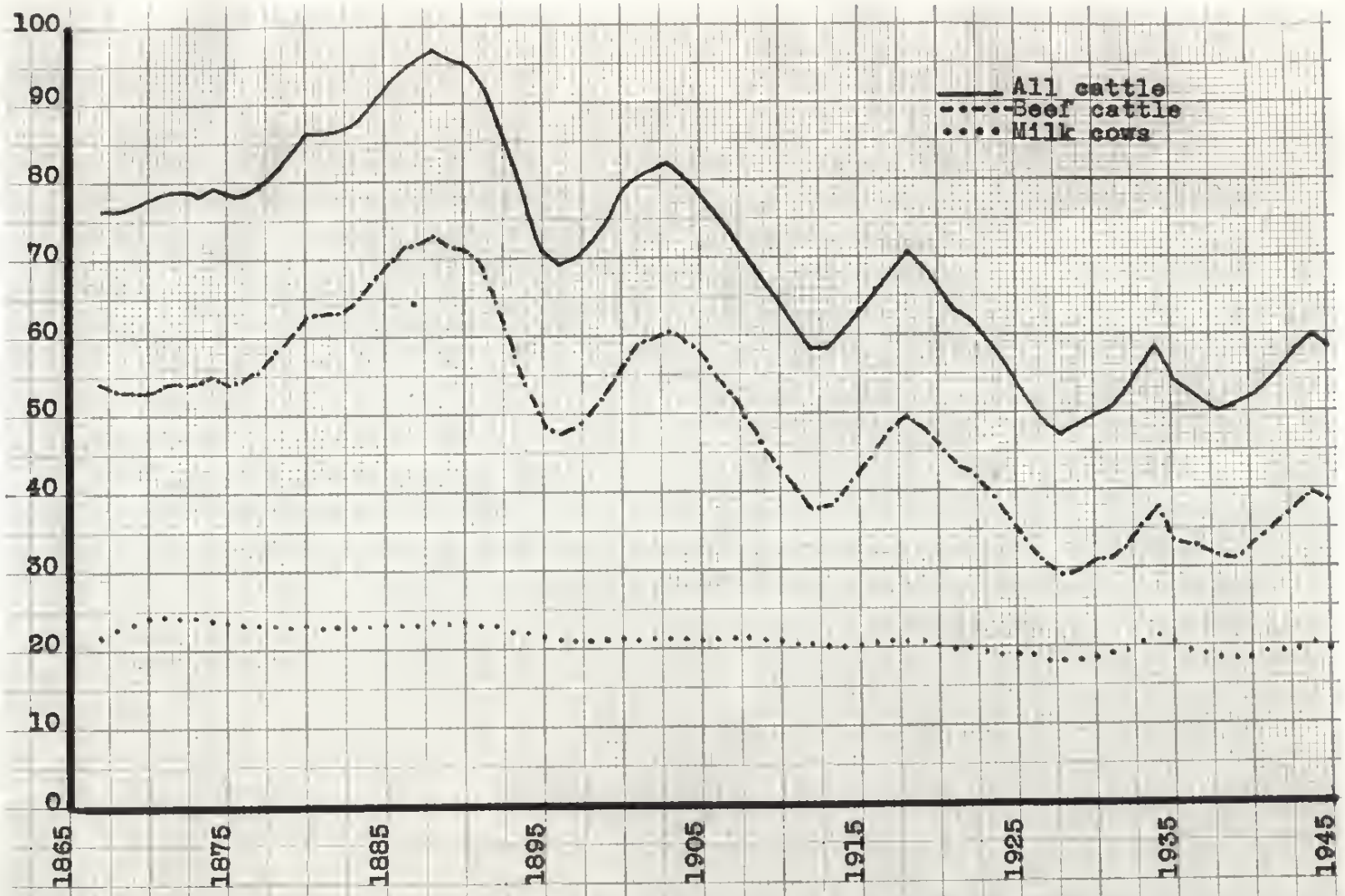

Figure 3. Number of cattle in the United States per one hundred human population from 1867 to 1945.

man population can be attributed largely to changes in beef cattle numbers. Beef cattle numbers decreased from 71.4 per hundred human population in 1890 to 39.6 in 1944, a reduction of 44.5 per cent as compared to the reduction of 37.4 per cent in all cattle.

In contrast with beef cattle the proportion of milk cows to human population has remained remarkably constant from 1867 to the present. Note the almost horizontal line in Fig. 3. The number of milk cows per one hundred of human population was 22.1 in 1867 and that ratio has changed little with population growth. The largest ratio was 24.3 in 1871 and 1872 and the lowest was 18.4 in 1928 and 1929. By 1944, the ratio had risen to 20 milk cows for one hundred of population. While human population increased 275 per cent from 1867 to 1945, milk cows increased 236 per cent to maintain a rather stable relationship between human population and milk cow numbers.

CATTLE PRODUCTION CYCLES

Definition of a Cattle Production Cycle

For this study, the definition of production and price cycles as given by Frederick Lundy Thomsen, formerly Professor of Agricultural Economics, University of Missouri, was adopted. Thomsen defines production and price cycles as "...changes in production and price which occur over a number of years with more or less regular periodicity, and which are self-energized or in which one part of the movement follows or is caused by another part. This regularity, plus the self-energizing feature of the cycle, makes it to a certain extent predictable."[8]

The periodic fluctuations in beef cattle numbers will be referred to as cycles as they conform to the qualifications present in Thomsen's definition of a production cycle. The wave-like patterns extend over an interval of years, are comparable in length, are similar in amplitude, and are reciprocal in factors involved in the processes of expansion and liquidation of numbers.

Each cycle is self-activating in that one part of the movement is a continuation of or is caused by the preceding part. For example, when the profits of the cattle industry are sufficient to enable producers to realize a good margin on their

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[8]Frederick Lundy Thomsen, Agricultural Prices (New York, c.1936) p. 203.

investment and to induce competitors to enter the field, a program of expansion begins which continues even after the profits have diminished and a state of over-production exists. Liquidation is likewise subjected to a sustained movement until the point of unprofitableness is passed and price has risen to meet the condition of scarcity and demand.

There are characteristics in each phase of the beef cattle cycle which make that phase or portions of it predictable to an extent. In the expansion phase of the cycle and just before the liquidation phase begins, there are times when marketings are increased because breeding stock is being reduced. A rather accurate estimate of the degree of liquidation can be obtained by observing the numbers of cows and heifers going to market. When the trough of beef cattle numbers has been reached and prices tend to be favorable, allowance must be made for the biological factor involved in enlarging a herd, and it becomes obvious that at that stage, three to five years must pass before a substantial increase in slaughtering is observed.

At best the beef cattle cycle can only approximate regularity for the actual contraction and expansion phases of production are influenced by external factors; namely, weather conditions, the size of the corn crop, range and pasture conditions, general business conditions, and the general price level. These factors not readily predictable have a marked effect on the cycle as a whole. It is the opinion of John A. Hopkins, Jr. that the major cattle cycles of the past 60 years

are due to forces outside the industry--forces which do not seem to be related to any orderly repeating occurrence.[9] However, it is the belief of others that the fluctuations caused by the unpredictable factors serve only to affect the length or emphasize the degree of cyclical variations and that there still remains a truly cyclical pattern of cattle production.[10] The latter interpretation was accepted in this thesis.

Description of Cycle in Beef Cattle Numbers

The fluctuations in beef cattle numbers are primarily responsible for the cyclical variation in cattle numbers. Since 1890 beef cattle have gone through four such complete cycles (figuring from peak to peak in numbers) assuming that the last peak was in 1944 and that cattle numbers now are definitely on the downward phase of the cycle.

Length of Cycle. The cycles vary considerably in length but it is of interest that the increasing phase has been much more consistent in its duration than the decreasing phase. (Table 4)

The factor of regularity in length of the expansion phase renders it more adaptable to prediction than the contraction phase where varying external conditions play a major role in the liquidation of beef cattle. The average of six and one-half years in the increasing portion of the cycle is much more

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[9] Hopkins, loc. cit., p. 351.
[10] Thomsen, op. cit., p. 360.

Table 4. Length of beef cattle cycle.

Period	Years of Increase Per Cycle	Years of Decrease Per Cycle	Length of Cycle in Years	Per cent of Change in Beef Cattle Numbers [1]	
				Period of Increase	Period of Decrease
1890-1896		6			- 26.7
1896-1904	8			+ 35.7	
			14		
1904-1912		8			- 30.0
1912-1918	6			+ 35.7	
			14		
1918-1928		10			- 37.5
1928-1934	6			+ 27.9	
			16		
1934-1938		4			- 15.0
1938-1944	6			+ 31.0	
			10		
Average	6½	7	13½	+ 32.6	- 27.3

[1] Period of increase and decline calculated from trend line.

reliable than the average of seven years in the declining portion where the variation has been as long as ten years and as short as four years in individual cycles. The great variation in the contraction phase of the cycle has affected the length of the four production cycles as a whole, which has varied considerably with ten years as the minimum length and 16 as the maximum or an average of 13½ years.

The shortest cycle was that from 1934 to 1944 and the longest cycle was that from 1918 to 1934. Some of this variation in length can be attributed to external factors. The severe drouth of 1934 actually brought to a close a normal period of expansion, which was underway, by forcing producers to liquidate a large percentage of their herds and thus start cattle numbers downward. This condition tended, perhaps, to shorten the sixteen year cycle which might have been longer under normal conditions.

On the other hand, the drouth of 1934 and another in 1936 had an accelerating effect on the contraction phase of the 1934 to 1944 cycle. Under the Agricultural Adjustment Act, the government in 1934 and 1935 purchased thousands of head of drouth-stricken cattle. This action had the effect of causing a sharp rise both in cattle price and cattle values and eliminated the cause for the long period of liquidation which usually follows the peak in numbers. Furthermore, the Agricultural Adjustment Act by placing a bonus on the utilization of grass and pasture land created a great quantity of cheap feed for cattle, particularly in the Corn Belt region. This also helped to decrease

the length of the declining phase of the 1934 to 1944 cycle which might have been of longer duration.

Amplitude of Cycle. Using the long time trend line for beef cattle numbers as a base, it was possible to calculate the per cent of change from this line for the peak and low years. The expansion phases of the four cycles (Table 4) show a much higher degree in regularity of change than does the liquidation phases.

The range of variation in the expansion period was from 35.7 per cent to 27.9 per cent, a difference of only 7.8 per cent. There appears to be a limit to the increase in cattle numbers taking place during the expansion phase. The average increase as calculated from the trend line is around 33 per cent and this increase or growth probably reaches the maximum capacity possible in each cycle for a given number of cattle on farms.

An increase of 33 per cent is a conservative estimate as the period from 1928 to 1934 which was a period of expansion was brought to a sudden close by the drouth of 1934; consequently, the low percentage increase in this period would have a tendency to lower the average for all four cycles. This rather consistent increase in numbers during the expansion phases of the cycles can undoubtedly be attributed to the profitableness of cattle raising during this period which causes producers to expand production to the maximum capabilities of their herds and feed supply in periods of expansion.

In the contraction phases of the cycles the degree of regularity was much less consistent. This lack of consistency can be attributed to the greater variations in length of this phase of the cycle and to the fact that liquidation of a herd can be brought about much more rapidly than the expansion of a herd. Again it is observed that the expansion phase, by its regularity of length and consistency in amplitude, lends itself more readily to predictions or forecasts than the contraction phase of the cycle.

Annual Rate of Change in Beef Cattle Numbers

To ascertain the degree of regularity in the rate of liquidation and in the rate of expansion of livestock for the four cycles studied, the difference in cattle numbers from a peak to a low period for each liquidation phase, and the difference in cattle numbers from a low to a peak period for each expansion phase was determined; each difference representing 100 per cent for its particular phase. The yearly variations for each phase were then calculated as a per cent of the total difference previously computed for that phase. These percentage changes from year to year, along with the number of cattle on farms and the purchasing power cycle, are presented graphically in Fig. 4. (Table 5)

Expansion Phase of Cycle. There was no definite regularity in the yearly variations of either the expansion or liquidation phases. In the expansion phase three to six years elapsed before the maximum yearly increase in any one phase was

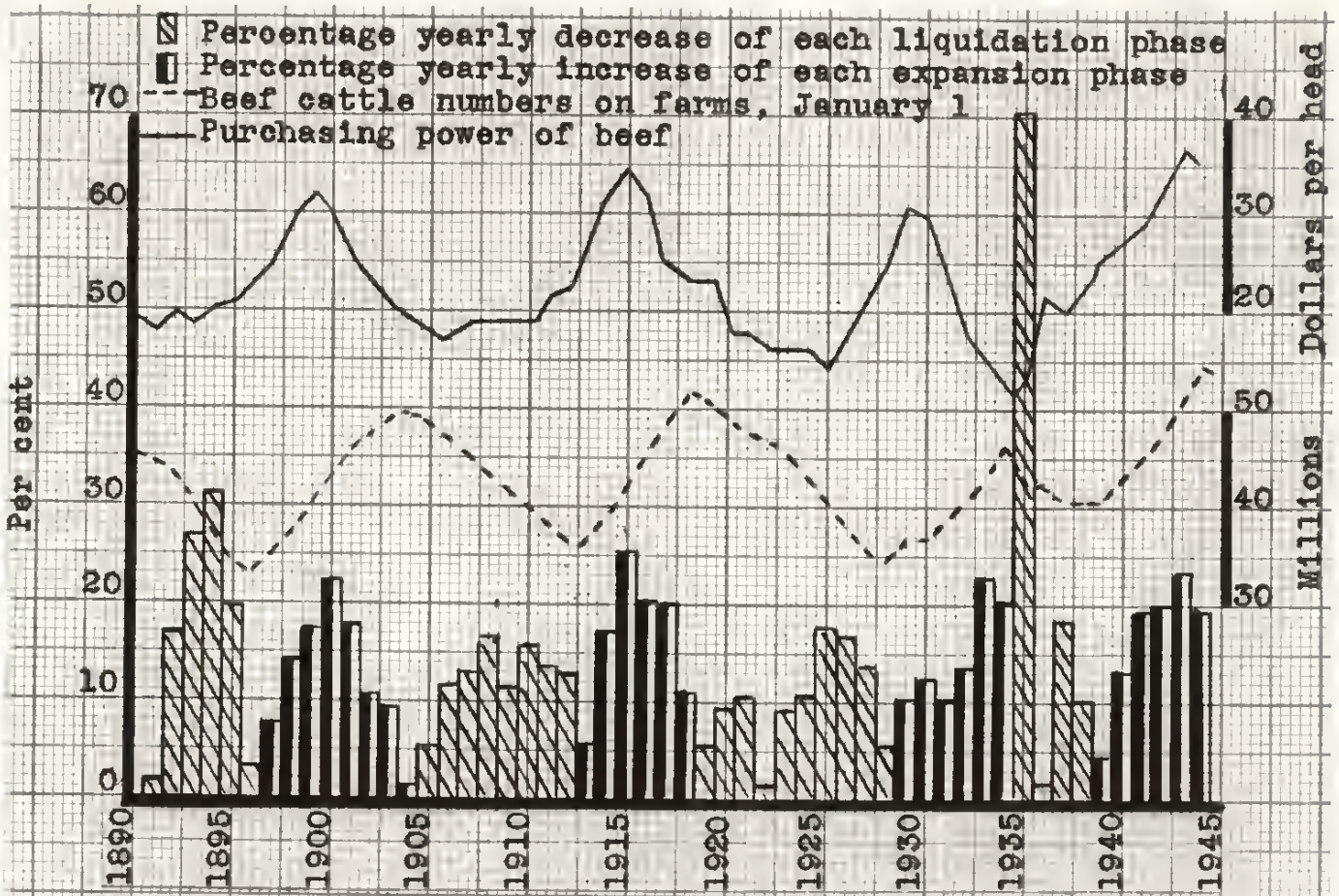

Figure 4. Purchasing power of beef cattle and beef cattle numbers related to the percentage yearly change of liquidation and expansion in beef cattle numbers.

Table 5. Percentage changes in liquidation and expansion phases of the cattle production cycle.

Year	Beef Cattle Numbers /1	Yearly Change in Numbers	Yearly Per Cent of Total Change	Purchasing Power /2
	Thous.	Thous.	%	Dollars
1890	45,014			19.04
1891	44,835	179	1.6	18.02
1892	42,949	1,886	17.0	19.71
1893	39,955	2,994	27.0	18.45
1894	36,476	3,479	31.4	20.25
1895	34,280	2,196	19.8	20.41
1896	33,939	341	3.1	22.62
Total Change /3		11,075		
1896	33,939			22.62
1897	35,065	1,126	7.5	24.41
1898	37,227	2,162	14.4	29.84
1899	39,833	2,606	17.4	31.92
1900	43,195	3,362	22.4	29.65
1901	45,868	2,673	17.8	24.89
1902	47,426	1,558	10.4	22.62
1903	48,787	1,361	9.1	20.30
1904	48,957	170	1.1	18.76
Total Change.		15,018		
1904	48,957			18.76
1905	48,288	669	5.2	17.11
1906	46,779	1,509	11.8	17.80
1907	45,125	1,654	12.9	18.09
1908	42,997	2,128	16.6	18.37
1909	41,573	1,424	11.1	18.37
1910	39,543	2,030	15.9	18.43
1911	37,803	1,740	13.6	21.37
1912	36,158	1,645	12.9	22.15
Total Change.		12,799		
1912	36,158			22.15
1913	37,012	854	5.6	26.06
1914	39,640	2,628	17.1	31.47
1915	43,579	3,939	25.7	34.06
1916	46,686	3,107	20.2	30.25
1917	49,767	3,081	20.1	24.45
1918	51,504	1,737	11.3	22.68
Total Change.		15,346		

Table 5. continued

	Thous.	Thous.	%	Dollars
1918	51,504			22.68
1919	50,549	955	5.8	22.70
1920	48,945	1,604	9.8	17.37
1921	47,258	1,687	10.3	17.45
1922	46,944	314	1.9	16.39
1923	45,408	1,536	9.4	15.70
1924	43,665	1,743	10.6	15.83
1925	40,798	2,867	17.5	14.99
1926	38,166	2,632	16.0	17.47
1927	35,927	2,239	13.6	19.94
1928	35,091	836	5.1	25.74
Total Change.		16,413		
1928	35,091			25.74
1929	36,437	1,346	10.9	30.59
1930	37,971	1,534	12.4	29.91
1931	39,210	1,239	10.0	24.54
1932	40,905	1,695	13.7	18.75
1933	44,344	3,439	27.9	15.95
1934	47,438	3,094	25.1	11.90
Total Change.		12,347		
1934	47,438			11.90
1935	42,764	4,674	70.2	12.28
1936	42,651	113	1.7	21.27
1937	41,449	1,202	18.1	19.39
1938	40,783	666	10.0	21.86
Total Change.		6,655		
1938	40,783			21.86
1939	41,429	646	4.6	25.09
1940	43,271	1,842	13.2	26.71
1941	45,983	2,712	19.5	28.37
1942	48,764	2,781	20.0	30.51
1943	52,008	3,244	23.3	36.25
1944	54,708	2,700	19.4	34.40
Total Change.		13,925		

/1 1946 Agricultural Outlook Charts, p. 78.

/2 Average Value per Head of Cattle, January 1, ÷ All Commodity Price Index for January. See Table 12.

/3 Difference in beef cattle numbers in liquidation phase from high to low, and in expansion phase, from low to high.

reached. It is interesting to note, too, that the maximum percentage change in all four expansion phases of the cycles ranged between 22 and 28 per cent, so that the limit to expansion in any one year was about 25 per cent of the total change in numbers or approximately 3.5 million head.

Liquidation Phase of Cycle. The liquidation phase of each cycle showed even less regularity in yearly percentage changes than did the expansion phase. Unlike the expansion phase, there is no biological factor limiting the extent of the change. Three to five years may be required for building up a herd which can be liquidated almost immediately. Liquidation is subject more to existing conditions at any particular time; expansion is a result of a decision based upon a forecast of future events and once the decision is made, little can be done to further increase the rate of expansion.

Slaughter as an Indication of Position in Cycle

The percentage of classes of cattle slaughtered in the United States, illustrated graphically in Fig. 5 (Table 6) gives an indication of the predominance of certain classes of cattle slaughtered during the various phases of the production cycle.

During the contraction phase of the cycle the percentage of cows and heifers slaughtered exceeded steers slaughtered for the greater part of the period. From 1920 to 1922, when liquidation progressed at a slow rate, cow and heifer slaughter was less than steer slaughter. However, the remaining six years of

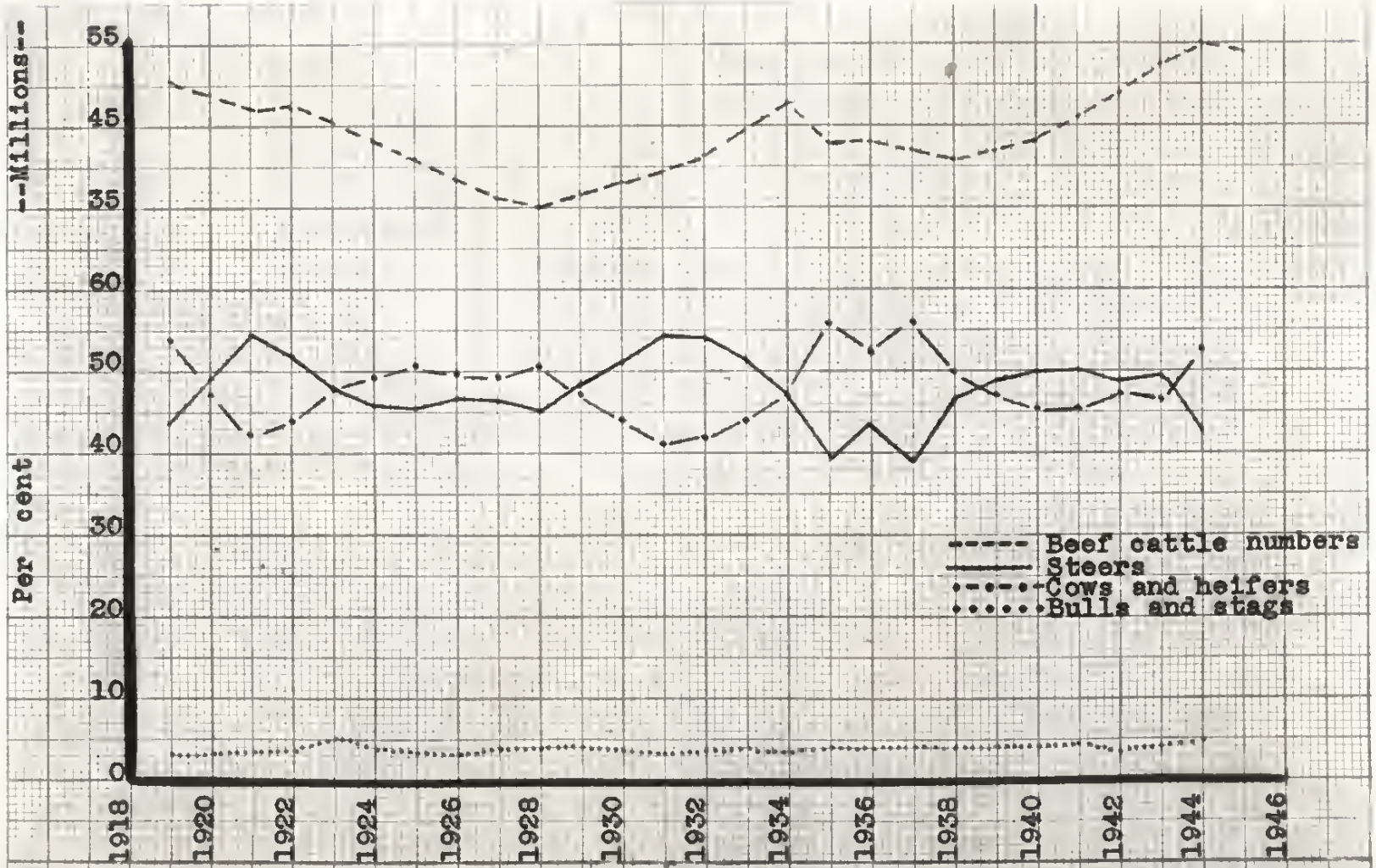

Figure 5. Percentage of classes of cattle slaughtered to total slaughter and the number of cattle other than milk cows on farms.

Table 6. Estimate of cattle slaughtered, total and by classes from 1919 to 1944. /1

Year	Total Cattle	Steers		Cows and Heifers		Bulls and Stags	
	Thous.	%	Thous. /2	%	Thous. /2	%	Thous. /2
1919	15,027	43.46	6,531	53.44	8,030	3.10	466
1920	13,470	49.38	6,651	47.42	6,387	3.20	431
1921	12,428	54.00	6,711	42.32	5,260	3.68	457
1922	13,706	52.24	7,160	44.01	6,032	3.75	514
1923	14,283	47.99	6,854	47.93	6,846	4.08	583
1924	14,750	46.48	6,856	49.42	7,289	4.10	605
1925	14,704	45.99	6,762	50.45	7,418	3.56	523
1926	14,766	46.85	6,918	49.74	7,345	3.40	502
1927	13,413	47.08	6,315	49.20	6,599	3.72	499
1928	12,028	45.42	5,463	50.68	6,096	3.90	469
1929	12,038	48.65	5,856	47.36	5,701	4.00	482
1930	12,056	51.88	6,255	44.34	5,346	3.78	456
1931	12,096	54.81	6,630	41.68	5,042	3.51	425
1932	11,980	54.51	6,530	41.90	5,020	3.59	430
1933	13,107	52.06	6,824	44.05	5,774	3.89	510
1934	15,071	47.90	7,219	48.66	7,334	3.44	518
1935	14,566	39.89	5,810	55.99	8,156	4.12	600
1936	15,897	43.73	6,952	52.20	8,298	4.07	647
1937	15,254	40.09	6,115	55.88	8,524	4.03	615
1938	14,822	46.20	6,848	49.75	7,374	4.05	600
1939	14,621	48.57	7,101	47.07	6,882	4.36	637
1940	14,971	49.88	7,468	45.93	6,876	4.19	627
1941	16,433	49.87	8,195	45.60	7,493	4.53	745
1942	17,981	48.74	8,764	47.41	8,525	3.85	692
1943	17,715	48.92	8,666	47.04	8,333	4.04	716
1944	20,065	42.00	8,427	52.90	10,614	5.10	1,023

/1 Livestock, Meats, and Wool Market Statistics and Related Data 1943, p. 46 and 1944, p. 17, 35.
/2 Data calculated.

the liquidation phase from 1922 to 1928 were characterized by an excess of cows and heifers slaughtered over steers slaughtered. On the other hand, for the entire liquidation phase of 1934 to 1938, when cattle raising was unprofitable and producers were aware of the situation, cows and heifers slaughtered exceeded steers slaughtered.

During the expansion phase as production started upward, the number of she stock slaughtered was reduced and a greater number of steers were slaughtered. (Fig. 6, Table 6) Two to three years before the peak in numbers was reached, the slaughter of breeding stock increased as cattle raising became less and less profitable and steer slaughter started to decrease.

While the percentage of the various classes slaughtered gives an indication of the phase of the cattle production cycle, the fact that any data on cow and heifer slaughter include both beef and dairy cattle, makes it impossible to predict, with any degree of certainty just what changes in numbers are due to beef cattle operations and what changes are due to dairy cattle operations. As changes in beef and dairy cattle numbers occur at different times and from different causes, there is no method of discerning from published data whether an increase of cow and heifer slaughter is due to the liquidation of beef cattle numbers, dairy cattle numbers or both. It is possible that a high percentage of total slaughter could be made up of cows and heifers and at the same time beef cattle numbers could be increasing. For example, if during the expansion phase of the beef cattle

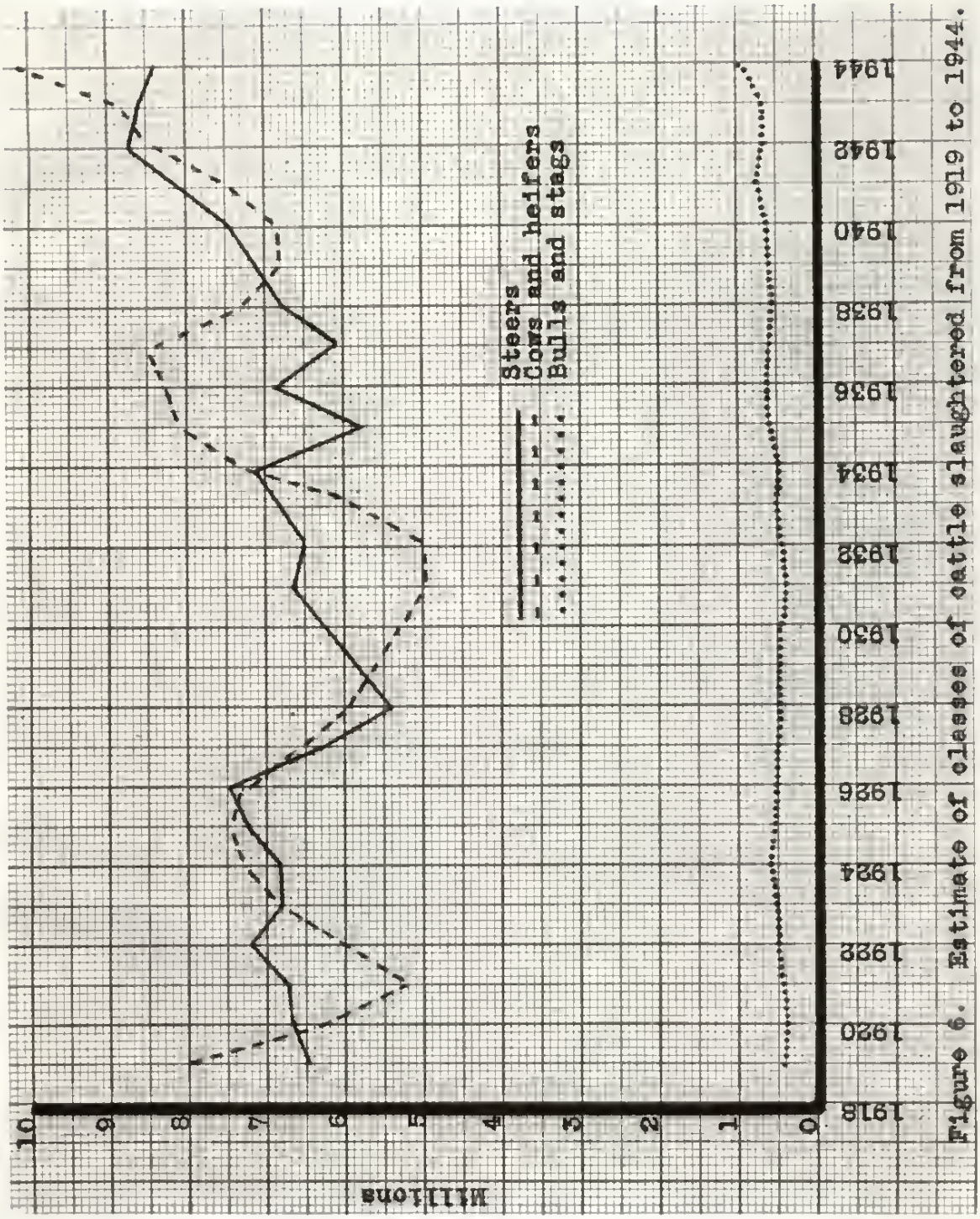

Figure 6. Estimate of classes of cattle slaughtered from 1919 to 1944.

production cycle, the normal number of cows and heifers from beef-breeding herds was being sent to market and at the same time, a sizeable number of cows and heifers from dairy herds was being marketed, the combined numbers would show an increase of cow and heifer slaughter which could be misinterpreted as being caused by large scale liquidation of beef breeding herds. As a whole dairy cattle numbers have been steadily increasing since 1890, but marked seasonal variations in numbers, while affecting the trend of slaughter at a given time, would have little, if any, influence upon the trend of dairy cattle numbers over a longer period.

RELATIONSHIP OF PRICE TO THE CATTLE PRODUCTION CYCLE

The Effect of Demand for Beef on Price of Beef

In livestock production as in other branches of industry, the price paid for a commodity depends in part upon the demand for it as expressed by the desire of individuals for that good plus their ability to purchase it. To support this theory, a comparison was made between retail price of beef and national per capita income.

The data used in comparing national per capita income to the retail price of beef covered the years 1913 to 1941. No earlier material was available than 1913 for national per capita income, and the years following 1941 were omitted purposely to avoid the influence of conditions present during the years of World War II with price subsidies on beef. Plotting the curves for both retail price of beef and national per capita income (Fig. 7, Table 7) showed that the two moved in the same direction with the major fluctuations in national per capita income being reflected in similar fluctuations in retail price of beef.

To measure this relationship a correlation study was made, and a correlation coefficient of .849 was obtained. (Fig. 8, Table 8) This correlation coefficient had a probability of less than .01 which means that by chance such a high correlation could occur less than one time out of a hundred.

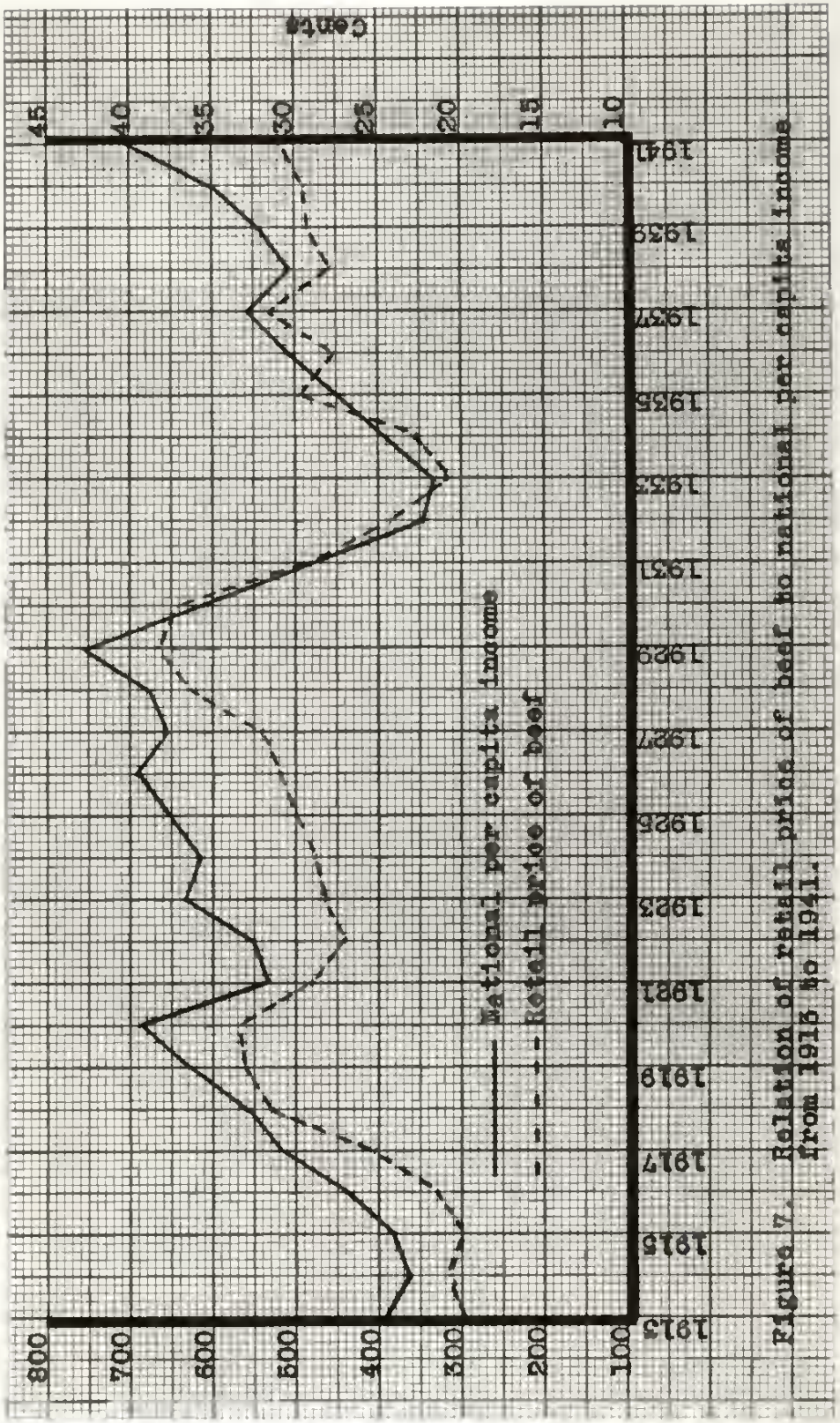

Figure 7. Relation of retail price of beef to national per capita income from 1913 to 1941.

Table 7. Retail price of beef and national per capita income from 1913 to 1941.

Year	National Per Capita Income /1	Retail Price Of Beef /2	Year	National Per Capita Income /1	Retail Price Of Beef /2
	Dollars	Cents		Dollars	Cents
1913	389	19.8	1927	659	31.9
1914	367	20.5	1928	678	36.4
1915	381	20.0	1929	706	38.2
1916	440	21.3	1930	609	35.2
1917	516	25.1	1931	480	29.2
1918	556	31.5	1932	347	24.2
1919	629	32.9	1933	332	20.9
1920	689	33.2	1934	389	22.7
1921	537	28.5	1935	441	29.6
1922	550	27.0	1936	510	27.8
1923	632	28.0	1937	552	31.6
1924	619	28.7	1938	508	27.9
1925	649	29.9	1939	543	28.6
1926	685	30.6	1940	591	28.7
			1941	707	30.7

/1 1946 Agricultural Outlook Charts, p. 77

/2 "Price Spreads Between Farmers and Consumers for Food Products", Misc. Publication No. 576. United States Department of Agriculture, Bureau of Agricultural Economics, September, 1945, p. 79-83.

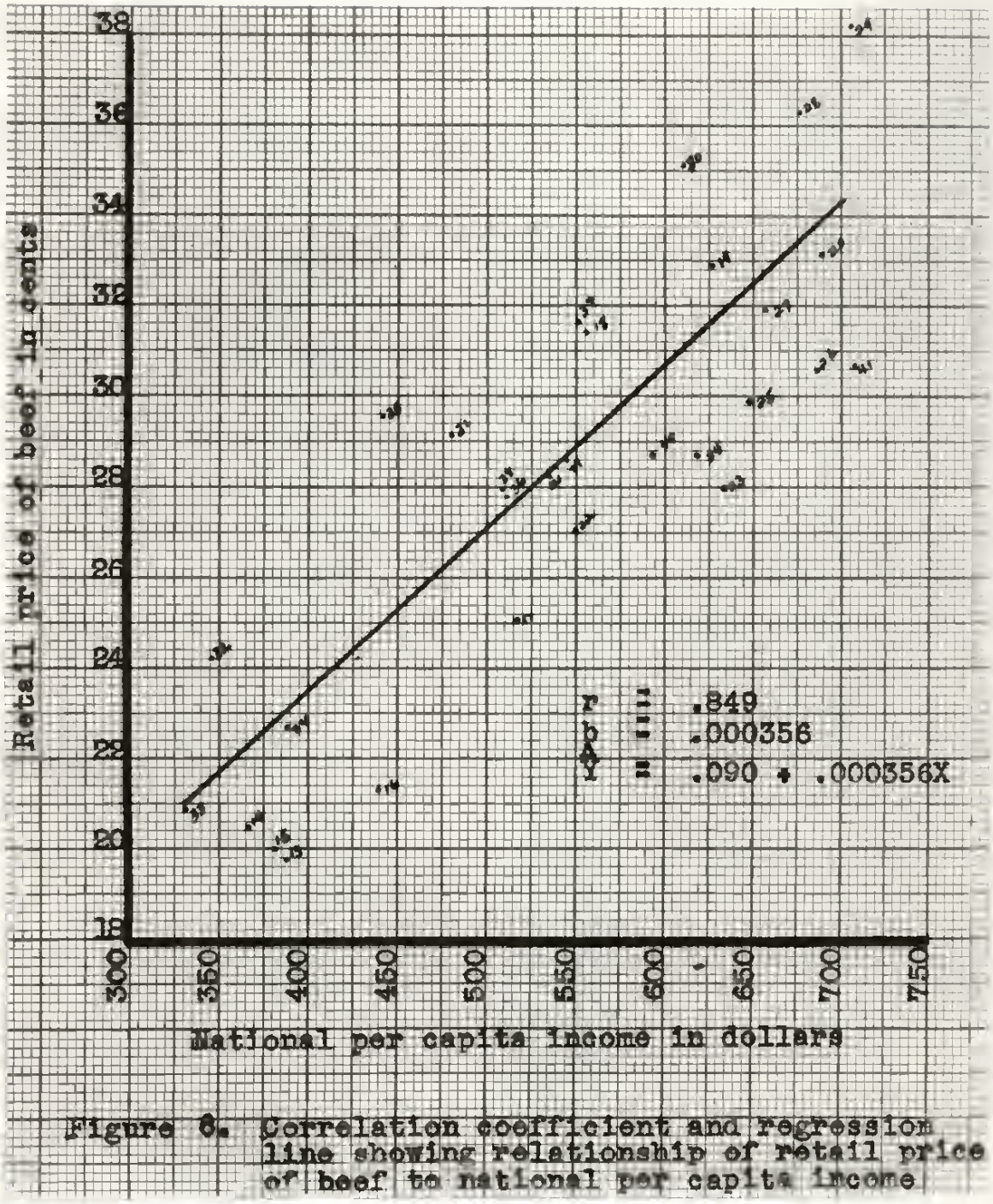

Figure 6. Correlation coefficient and regression line showing relationship of retail price of beef to national per capita income

Table 8. Figures for calculation of correlation and regression coefficients for retail price of beef and national per capita income

Year	National Per Capita Income X /1	X^2	Beef Retail Prices Y /2	Y^2	XY
	Dollars		Cents		
1913	389	151,321	19.8	392.04	77.022
1914	367	134,689	20.5	420.25	75.235
1915	381	145,161	20.0	400.00	76.200
1916	440	193,600	21.3	453.69	93.720
1917	516	266,256	25.1	630.01	129.516
1918	556	309,136	31.5	992.25	175.140
1919	629	395,641	32.9	1,082.41	206.941
1920	689	474,721	33.2	1,102.24	228.748
1921	537	288,369	28.5	812.25	153.045
1922	550	302,500	27.0	729.00	148.500
1923	632	399,424	28.0	784.00	176.960
1924	619	383,161	28.7	823.69	177.653
1925	649	421,201	29.9	894.01	194.051
1926	685	469,225	30.6	936.36	209.610
1927	659	434,281	31.9	1,017.61	210.221
1928	678	459,684	36.4	1,324.96	246.792
1929	706	498,436	38.2	1,459.24	269.692
1930	609	370,881	35.2	1,239.04	214.368
1931	480	230,400	29.2	852.64	140.160
1932	347	120,409	24.2	585.64	83.974
1933	332	110,224	20.9	436.81	69.388
1934	389	151,321	22.7	515.29	88.303
1935	441	194,481	29.6	876.16	130.536
1936	510	260,100	27.8	772.84	141.780
1937	552	304,704	31.6	998.56	174.432
1938	508	258,064	27.9	778.41	141.732
1939	543	294,849	28.6	817.96	155.298
1940	591	349,281	28.7	823.69	169.617
1941	707	499,849	30.7	942.49	217.049

/1 1946 Agricultural Outlook Charts, p. 77.

/2 "Price Spreads Between Farmers and Consumers for Food Products", Misc. Publications No. 576. United States Department of Agriculture, Bureau of Agricultural Economics, September 1945, p. 79-83.

The fact that the correlation between national per capita income and retail price of beef was high, is not a basis for determining that one is the cause and the other the effect. A statistical analysis merely shows that a relationship exists, but it does not warrant the conclusion that one factor is dependent upon the other.

A correlation was computed for national per capita income and beef steer prices with a resulting correlation coefficient of .6962 and a probability of less than .01. (Fig. 9, Table 9) Both correlations point toward the supposition that national per capita income undoubtedly is one of the major factors affecting the level of cattle prices.

The Effect of the Supply of Beef on Beef Prices

To determine the effect that beef supply had on beef prices, a means of measuring the relationship of supply to the price of beef was required. It was found necessary to compare total beef production as measured by the dressed weight of total slaughter with beef prices.

Cattle numbers on farms were not used as a basis of beef production because the exact percentage and age of the various classes of cattle on farms was not available and it was impossible to determine the phase of the cycle and the degree of liquidation or expansion taking place at a particular time. If these factors are not known, it would be impossible to come to any conclusion because a large number of cattle on farms in a given year

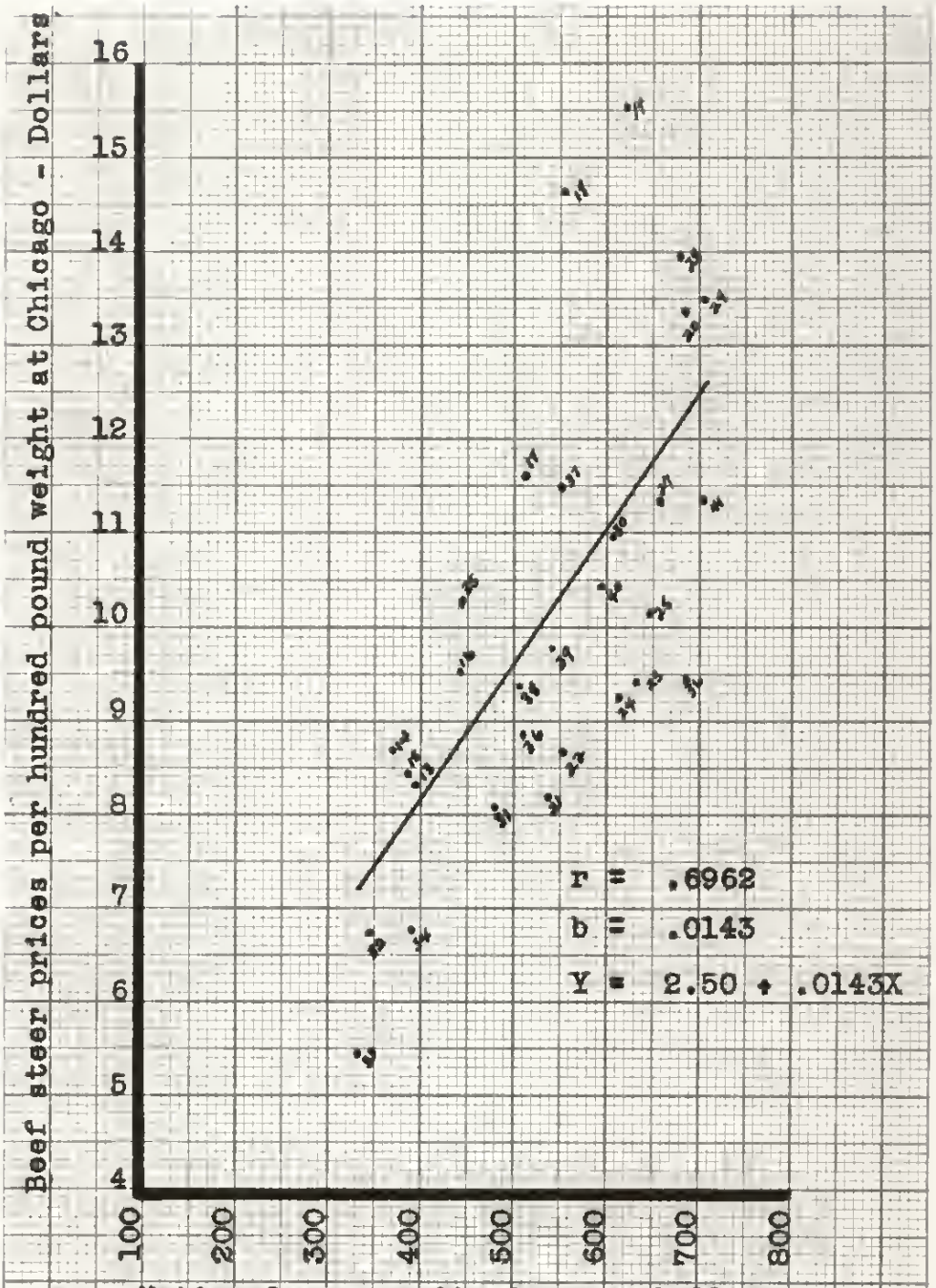

Figure 9. Correlation coefficient and regression line showing relationship of national per capita income to average price of all grades of beef steers at Chicago.

Table 9. Figures for calculation of correlation and regression coefficients for beef steer prices (per hundred wt.) and national per capita income.

Year	National Per Capita Income X [1]	x^2	Beef Steer Prices Y [2]	y^2	XY
	Dollars		Dollars		
1913	389	151,321	8.25	68.06	3,209.25
1914	367	134,689	8.65	74.82	3,174.55
1915	381	145,161	8.40	70.56	3,200.40
1916	440	193,600	9.50	90.25	4,180.00
1917	516	266,256	11.60	134.56	5,985.60
1918	556	309,136	14.65	214.62	8,145.40
1919	629	395,641	15.50	240.25	9,749.50
1920	689	474,721	13.30	176.89	9,165.70
1921	537	288,369	8.20	67.24	4,403.40
1922	550	302,500	8.65	74.82	4,757.50
1923	632	399,424	9.40	88.36	5,940.80
1924	619	383,161	9.24	85.38	5,719.56
1925	649	421,201	10.16	103.23	6,593.84
1926	685	469,225	9.47	89.68	6,486.95
1927	659	434,281	11.36	129.05	7,486.24
1928	678	459,684	13.91	193.49	9,430.98
1929	706	498,436	13.43	180.36	9,481.58
1930	609	370,881	10.95	119.90	6,668.55
1931	480	230,400	8.06	64.96	3,868.80
1932	347	120,409	6.70	44.89	2,324.90
1933	332	110,224	5.42	29.38	1,799.44
1934	389	151,321	6.76	45.70	2,629.64
1935	441	194,481	10.26	105.27	4,524.66
1936	510	260,100	8.82	77.79	4,498.20
1937	552	304,704	11.47	131.56	6,331.44
1938	508	258,064	9.39	88.17	4,770.12
1939	543	294,849	9.75	95.06	5,294.25
1940	591	349,281	10.43	108.78	6,164.13
1941	707	499,849	11.33	128.37	8,010.31

[1] 1946 Agricultural Outlook Charts, p. 77.

[2] Livestock, Meats, and Wool Market Statistics and Related Data, 1944, p. 45.

would not necessarily mean large marketings. Marketings might actually be decreasing and the increase in cattle numbers would be reflecting the number of cows and heifers retained for breeding purposes.

Market receipts were not used as a basis of the supply factor as adverse seasonal conditions such as drought and small feed crops could result in a greater number of cattle being sent to market without showing any appreciable change in the quantity of beef produced in normal years.

On the basis that the yearly total beef production would show a more concrete relationship between supply of beef and price of beef because the effects of short-time fluctuations would be minimized, a correlation analysis was made between the weighted average of beef cattle prices and the total yearly beef production.

Table 10 shows the correlation coefficient for several combinations of beef production and beef prices. With no time lag between production and price there appears to be no significant correlation. It may be that any direct correlation was hidden by factors affecting feeding, grazing, and general management activities which may have entered into the production and price data in such a way as to obscure the true relationship between supply and price.

Time lags between production and price were used to see if the price for any one year might not influence in some way the production policies which would determine the extent of future

Table 10. Correlation coefficients on beef production and beef prices.

Lag Between Price and Production	Correlation Coefficient	Probability △1
No lag.	+ .0627	N. S.
1 year lag.	- .2412	N. S.
2 year lag.	- .3997	.04
3 year lag.	- .3327	.07
4 year lag.	- .0999	N. S.

△1 A probability of 10 per cent or more is non-significant.

beef supplies. Time lags as great as ten years between production and price were used, but the only significant correlation obtained was that with a two year lag. This correlation was negative--that is, a high price for beef this year would mean a low production of beef two years hence and vice versa. The probability was slightly greater than .04 indicating that this negative correlation could not be discounted as a chance occurrence. However, the large concentration around the regression line between $5.50 and $6.50 in Fig. 10 (Table 11) implies that unmeasurable and unpredictable factors may have caused this close correlation.

A negative correlation for a two year lag between production and price can be explained logically in that a high price results in large profits which stimulate production activities and decrease total slaughter. A low price results in unfavorable profits which, if they persist, lead to increased marketings. A time lag of two years for the majority of producers to react to a present situation seems reasonable. The fact that a lag of three years is also negative and has a correlation coefficient of .3327 with a probability of .07 is some indication that these negative correlation coefficients are significant.

The Effect of Purchasing Power of Beef on Beef Cattle Numbers

To make a comparison between beef cattle prices and beef cattle numbers, a deflated average of January 1 farm value per head of beef cattle on farms for the period 1890 to 1945 was used.

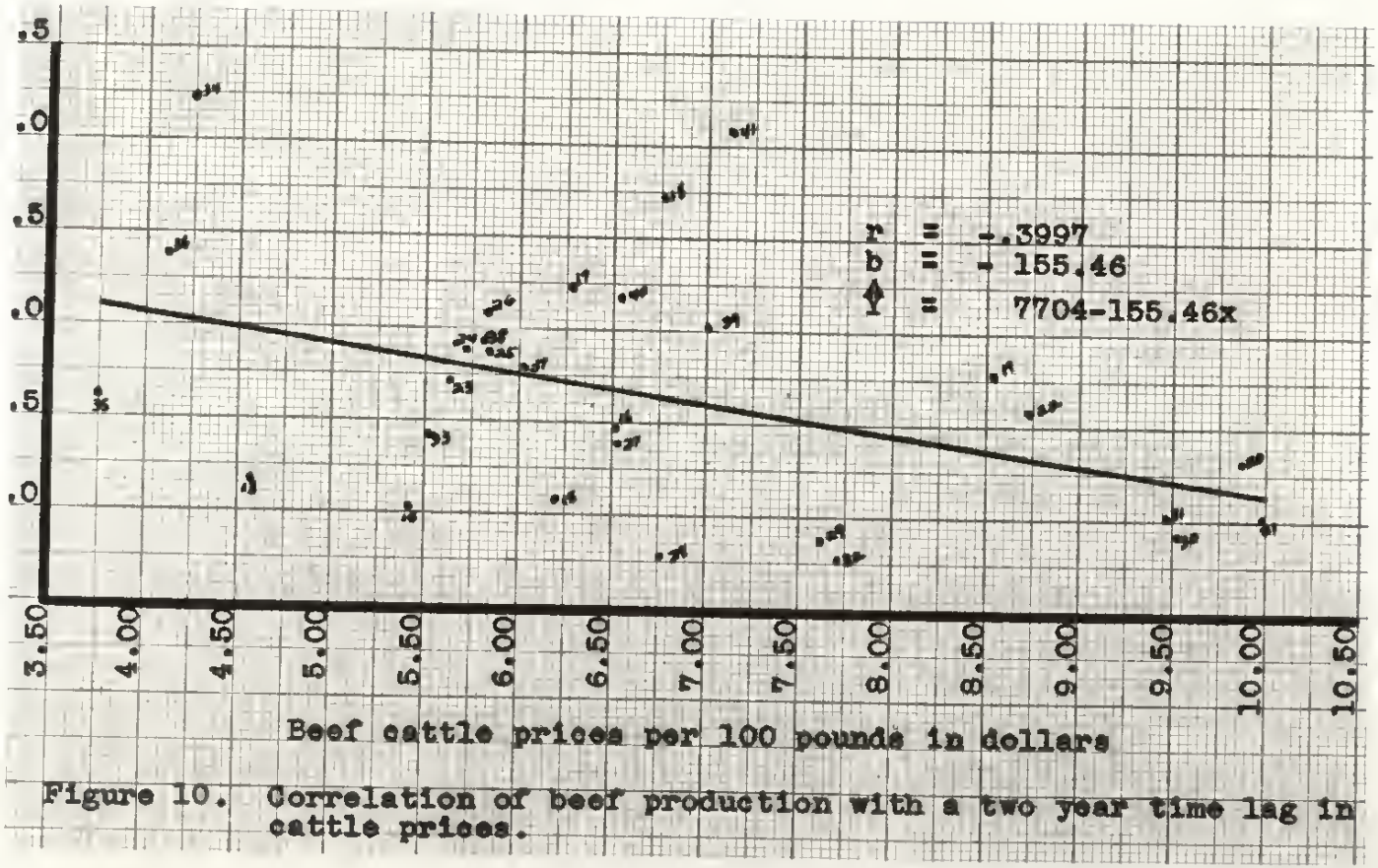

Figure 10. Correlation of beef production with a two year time lag in cattle prices.

Table 11. Two year lag in total beef produced with beef-cattle prices.

Year	Total Beef Production Y /1	Year	Prices of Beef Cattle X /2
	Millions		Dollars
1913	6,182	1911	4.57
1914	6,017	1912	5.43
1915	6,075	1913	6.20
1916	6,460	1914	6.52
1917	7,239	1915	6.26
1918	7,726	1916	6.76
1919	6,756	1917	8.54
1920	6,306	1918	9.88
1921	6,022	1919	9.97
1922	6,588	1920	8.71
1923	6,721	1921	5.63
1924	6,877	1922	5.73
1925	6,878	1923	5.84
1926	7,089	1924	5.84
1927	6,395	1925	6.53
1928	5,771	1926	6.75
1929	5,871	1927	7.62
1930	5,917	1928	9.52
1931	6,009	1929	9.47
1932	5,789	1930	7.71
1933	6,440	1931	5.53
1934	8,246	1932	4.25
1935	6,605	1933	3.75
1936	7,358	1934	4.13
1937	6,798	1935	6.04
1938	6,908	1936	5.82
1939	7,011	1937	7.00
1940	7,182	1938	6.54
1941	8,092	1939	7.14

/1 Livestock, Meats, and Wool Market Statistics and Related Data 1944, p. 70.

/2 Livestock, Meats, and Wool Market Statistics and Related Data 1943, p. 68.

This deflated value was computed by dividing the January 1 value of beef cattle by the index number of all commodities for January. (Table 12) The purpose of this procedure was to eliminate so far as possible the fluctuations caused by the general price level. The resulting calculations referred to as purchasing power show what the movement of beef cattle prices would have been if the general price level had remained constant.

Purchasing power of beef passes through a cycle similar to that of beef cattle numbers; however, the peak in the purchasing power cycle did not occur until several years after the low point in the production cycle had been reached. (Fig. 11) This condition is apparently the result of the fact that at the trough of the production cycle when purchasing power is starting to rise, farmers and producers begin to hold back breeding stock from the market, which action in itself would reduce marketings and tend to raise purchasing power. (Fig. 11) This situation continues until expansion has been carried to the point at which marketings increase and purchasing power is lowered.

The peak in numbers came three to five years after the high point in purchasing power was indicated. This may have been because the profits were relatively large at the time of the peak in purchasing power which induced producers to continue expanding their herds and encouraged new producers to enter the field. As production expanded and marketings increased, purchasing power declined until a point was reached at which producers reduced operations. With production on farms decreasing, the cattle numbers started downward and as liquidation progressed, purchasing

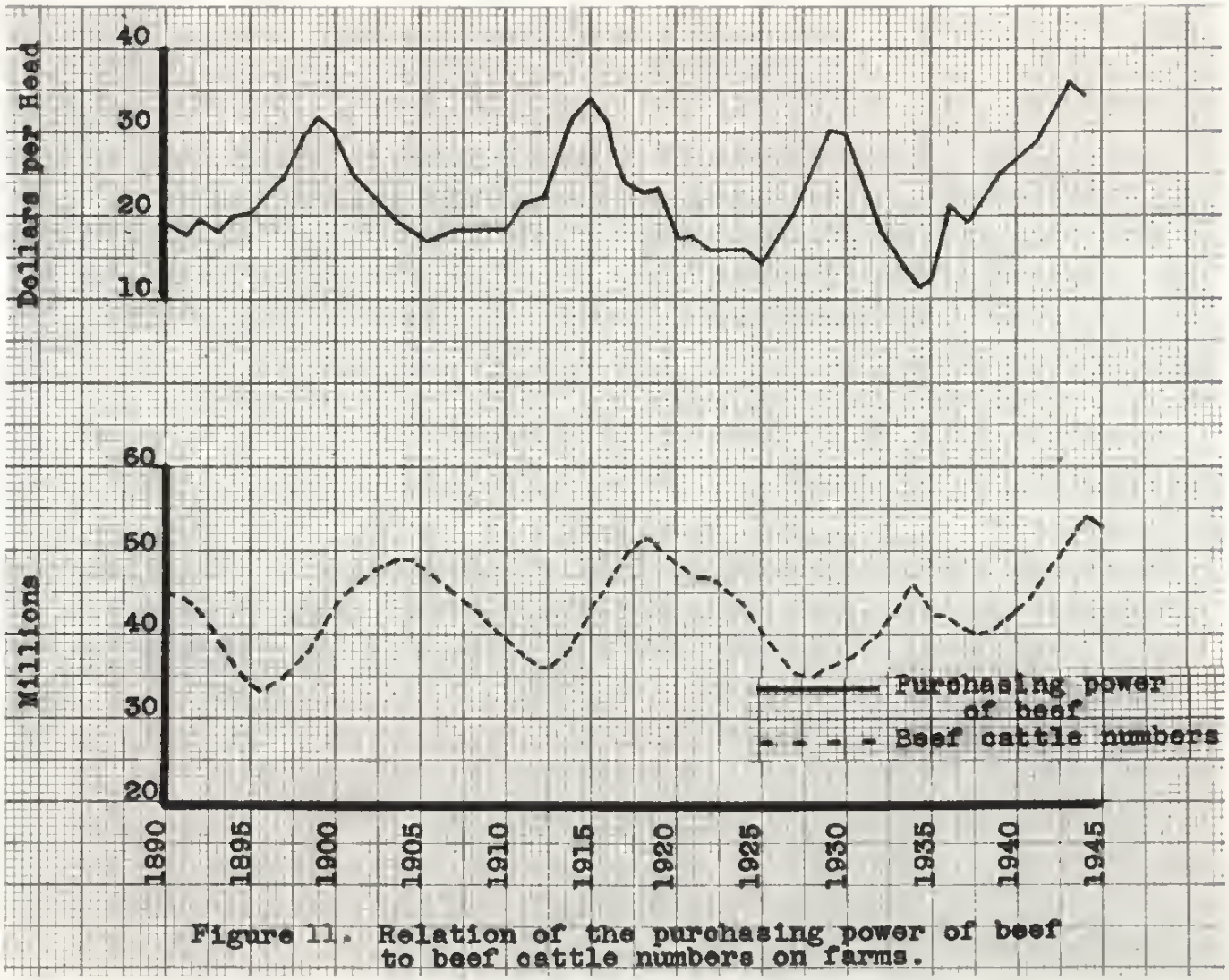

Figure 11. Relation of the purchasing power of beef to beef cattle numbers on farms.

Table 12. Average farm value per head of cattle other than milk cows on farms in the United States on January 1.

Year	Average Value Per Head Jan. 1 [1]	All Commodity Price Index [2]	Purchasing Power [3]	Year	Average Value Per Head Jan. 1 [1]	All Commodity Price Index [2]	Purchasing Power [3]
	Dollars		Dollars		Dollars		Dollars
1890	15.21	79.9	19.04	1905	15.14	88.5	17.11
1891	14.76	81.9	18.02	1906	15.88	89.2	17.80
1892	15.16	76.9	19.71	1907	16.90	93.4	18.09
1893	15.24	82.6	18.45	1908	16.70	90.9	18.37
1894	14.66	72.4	20.25	1909	17.32	94.3	18.37
1895	14.06	68.9	20.41	1910	19.20	104.2	18.43
1896	15.86	70.1	22.62	1911	20.62	96.5	21.37
1897	16.65	68.2	24.41	1912	21.35	96.4	22.15
1898	20.92	70.1	29.84	1913	26.74	102.6	26.06
1899	22.79	71.4	31.92	1914	31.50	100.1	31.47
1900	24.67	83.2	29.65	1915	33.86	99.4	34.06
1901	20.06	80.6	24.89	1916	34.00	112.4	30.25
1902	18.75	82.9	22.62	1917	36.45	149.1	24.45
1903	18.55	91.4	20.30	1918	41.39	182.5	22.68
1904	16.36	87.2	18.76	1919	44.53	196.2	22.70

Table 12. continued

Year	Average Value Per Head Jan. 1	All Commodity Price Index	Purchasing Power	Year	Average Value Per Head Jan. 1	All Commodity Price Index	Purchasing Power
	Dollars		Dollars		Dollars		Dollars
1920	39.99	230.2	17.37	1933	14.21	89.1	15.95
1921	29.04	166.4	17.45	1934	12.54	105.4	11.90
1922	21.87	133.4	16.39	1935	14.12	115.0	12.28
1923	23.38	148.9	15.70	1936	25.04	117.7	21.27
1924	23.01	145.4	15.83	1937	24.32	125.4	19.39
1925	22.52	150.2	14.99	1938	25.82	118.1	21.86
1926	26.32	150.7	17.47	1939	28.18	112.3	25.09
1927	28.10	140.9	19.94	1940	30.96	115.9	26.76
1928	36.22	140.7	25.74	1941	33.48	118.0	28.37
1929	42.82	140.0	30.59	1942	42.74	140.1	30.51
1930	40.38	135.0	29.91	1943	53.94	148.8	36.25
1931	28.03	114.2	24.54	1944	51.87	150.8	34.40
1932	18.41	98.2	18.75				

/1 Agricultural Statistics 1942, p. 369; 1944, p. 284

/2 Livestock, Meats, and Wool Market Statistics and Related Data 1943, p. 80; 1944, p. 58.
Index Numbers for January. Base period 1910 to 1914 = 100.

/3 Average Value per Head, January 1, divided by All Commodity Price Index for Month of January.

power tended to rise until that point was reached that again made conditions for expansion favorable.

The above interpretation of the number and purchasing power cycles implies that producers of beef cattle tend to respond more to present purchasing power conditions than to the prospect of future changes in purchasing power, for when purchasing power is high, few producers are contributing to marketings; while when purchasing power is low, marketings are greatest. With present methods of price and production forecasts and "out-look" data available, it is probable that farmers and producers will use more sound economic information in deciding upon their livestock programs.

The Effect of Purchasing Power on Supply

By comparing the number of cattle slaughtered to the purchasing power of beef cattle, it was possible to show the general effect of purchasing power upon the supply of cattle going to market. This relationship is shown graphically in Fig. 12 (Table 13). There is a definite inverse correlation between cattle slaughter and purchasing power.

From the data available, the peaks in total cattle slaughter lagged the peaks in purchasing power three to five years. Eliminating 1941 to 1945 purchasing power figures which reflect the abnormal war time demand, the peaks in purchasing power figures for the remaining high periods came at a time when cattle slaughter (which represents supply) was at its low point. This implies

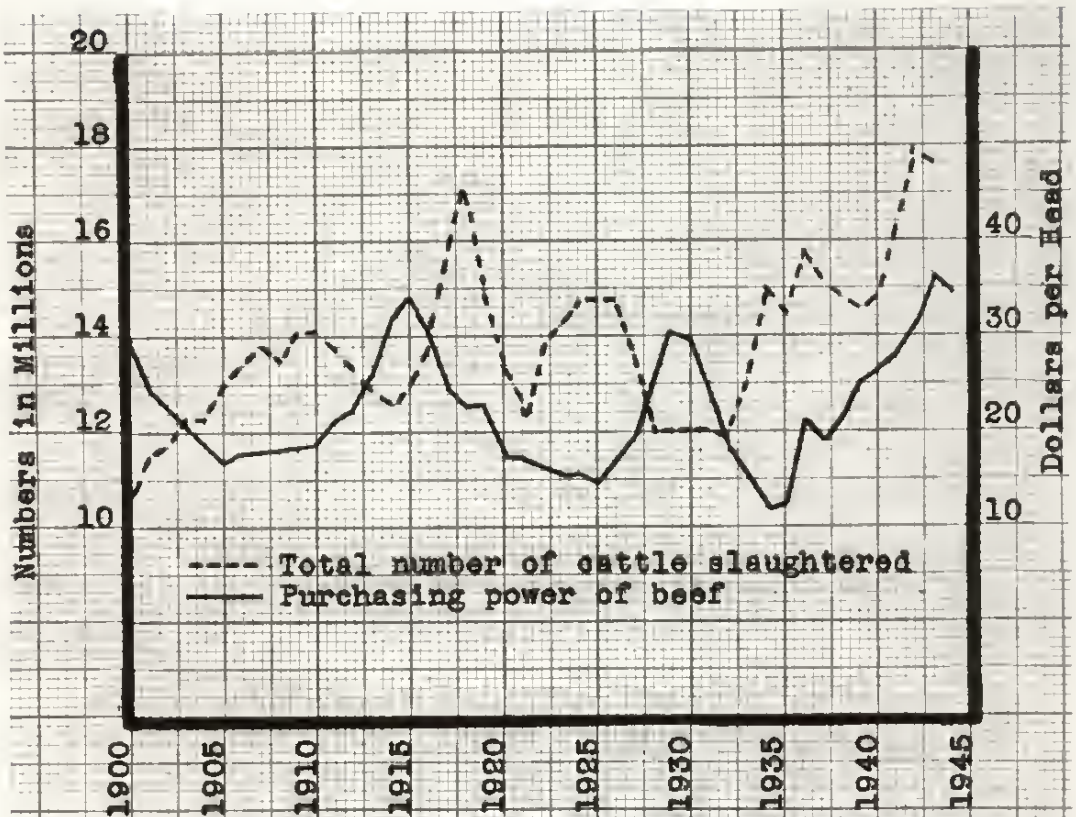

Figure 12. Comparison of total number of cattle slaughtered to the purchasing power of beef.

Table 13. Purchasing power of cattle (other than milk cows) on farms in the United States on January 1, and total cattle slaughter, 1900 to 1944.

Year	Purchasing Power /1	Total Cattle Slaughter /2	Year	Purchasing Power /1	Total Cattle Slaughter /2
	Dollars	Thous.		Dollars	Thous.
1900	29.65	10,792	1923	15.70	14,283
1901	24.89	11,526	1924	15.83	14,750
1902	22.62	11,751	1925	14.99	14,704
1903	20.30	12,266	1926	17.47	14,766
1904	18.76	12,257	1927	19.94	13,413
1905	17.11	13,096	1928	25.74	12,028
1906	17.80	13,456	1929	30.59	12,038
1907	18.09	13,886	1930	29.91	12,056
1908	18.37	13,569	1931	24.54	12,096
1909	18.37	14,135	1932	18.75	11,980
1910	18.43	14,140	1933	15.95	13,107
1911	21.37	13,817	1934	11.90	15,071
1912	22.15	13,386	1935	12.28	14,566
1913	26.06	12,939	1936	21.27	15,897
1914	31.47	12,676	1937	19.39	15,254
1915	34.06	12,901	1938	21.86	14,822
1916	30.25	13,793	1939	25.09	14,621
1917	24.45	15,741	1940	26.71	14,971
1918	22.68	17,093	1941	28.37	16,433
1919	22.70	15,027	1942	30.51	17,981
1920	17.37	13,470	1943	36.25	17,715
1921	17.45	12,428	1944	34.40	20,065
1922	16.39	13,706			

/1 See Table 12 for calculations

/2 Livestock, Meats, and Wool Market Statistics and Related Data 1943, p. 29; 1944, p. 17.

that producers responded to the high prices by continuing to expand their breeding herds resulting in a reduction in marketings. In fact, slaughter was at a relatively low point two to three years before the peak in purchasing power which infers that with a rise in purchasing power, producers entered into an expansion program which was well underway when the peak in the purchasing power cycle was reached.

Although there was no regularity in the yearly percentage increase in numbers in the expansion phases of the cattle cycle, a comparison of the yearly percentage variations with the purchasing power cycle, showed that the peaks of the percentage changes in two out of four cycles coincided with the peaks in the purchasing power cycle. In one of the other two cycles, the peak in percentage change lagged by one year the peak in the purchasing power cycle, and in the other, the peak of percentage change came four years after the corresponding peak in the purchasing power cycle. (Fig. 13, Table 14)

The most logical explanation of this relationship between peaks is that during the first three or four years of the expansion phase of the cattle cycle before either peak is reached, a large proportion of cows and heifers have been retained for breeding purposes and marketings are relatively low. Low marketings and limited production have a tendency to support a high purchasing power. After the third, fourth, or fifth year, when the greatest percentage increase in cattle numbers occurs, (which can be attributed to the calving of cows and heifers retained on farms at the trough periods of the cycle), marketings increase and purchasing power tends to decline.

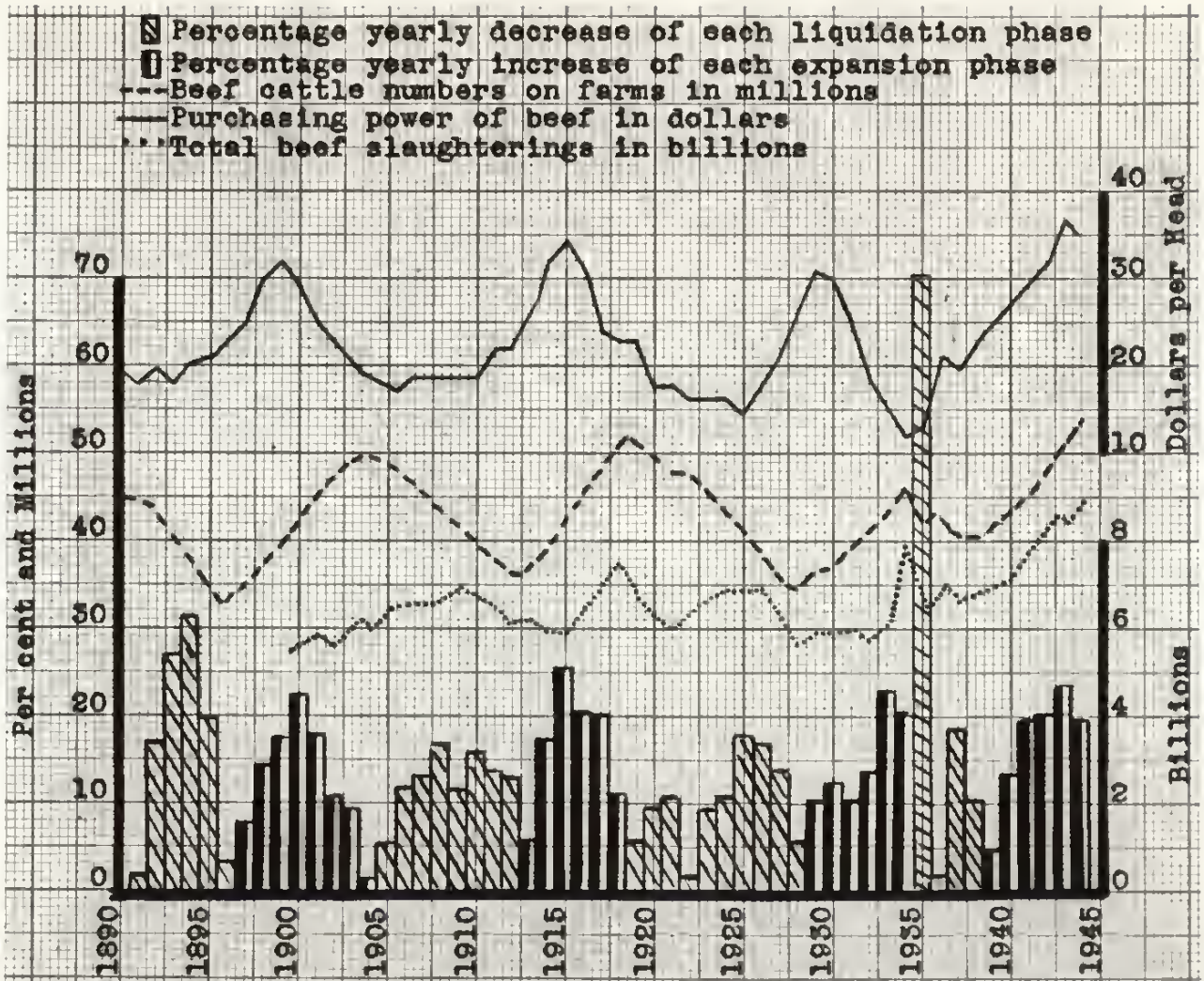

Figure 13. Purchasing power of beef cattle, total slaughterings, and beef cattle numbers related to the percentage yearly change of liquidation and expansion in beef cattle numbers.

Table 14. Purchasing power of beef cattle, beef cattle numbers, and total slaughterings.

Year	Purchasing Power /1	Beef Cattle Numbers /2	Total Slaughterings in Pounds /3
	Dollars	Thous.	Millions
1890	19.04	45,014	
1891	18.02	44,856	
1892	19.71	42,949	
1893	18.45	39,955	
1894	20.25	36,476	
1895	20.41	34,280	
1896	22.62	33,959	
1897	24.41	35,065	
1898	29.84	37,227	
1899	31.92	39,853	5,522
1900	29.65	43,195	5,628
1901	24.89	45,868	5,814
1902	22.62	47,426	5,649
1903	20.30	48,787	6,240
1904	18.76	48,957	6,176
1905	17.11	48,288	6,504
1906	17.80	46,779	6,537
1907	18.09	45,125	6,544
1908	18.37	42,997	6,662
1909	18.37	41,573	6,915
1910	18.43	39,543	6,647
1911	21.37	37,803	6,549
1912	22.15	36,158	6,234
1913	26.06	37,012	6,182
1914	31.47	39,640	6,017
1915	34.06	43,579	6,075
1916	30.25	46,686	6,460
1917	24.45	49,767	7,239
1918	22.68	51,504	7,726
1919	22.70	50,549	6,756

Table 14. continued

Year	Purchasing Power	Beef Cattle Numbers	Total Slaughterings in Pounds
	Dollars	Thous.	Millions
1920	17.37	48,945	6,306
1921	17.45	47,258	6,022
1922	16.39	46,944	6,588
1923	15.70	45,408	6,721
1924	15.83	43,665	6,877
1925	14.99	40,798	6,878
1926	17.47	38,166	7,089
1927	19.94	35,927	6,395
1928	25.74	35,091	5,771
1929	30.59	36,437	5,871
1930	29.91	37,971	5,917
1931	24.54	39,210	6,009
1932	18.75	40,905	5,789
1933	15.95	44,344	6,440
1934	11.90	47,438	8,246
1935	12.28	42,764	6,605
1936	21.27	42,651	7,358
1937	19.39	41,449	6,798
1938	21.86	40,783	6,908
1939	25.09	41,429	7,011
1940	26.76	43,271	7,182
1941	28.37	45,983	8,092
1942	30.51	48,764	8,831
1943	36.25	52,008	8,523
1944	34.40	54,708	9,137

/1 See Table 12 for calculations
/2 1946 Agricultural Outlook Charts, p. 78
/3 Livestock, Meats, and Wool Market Statistics and Related Data 1944, p. 70.

SUMMARY AND CONCLUSIONS

The purpose of this study was to collect and systematize data relating to the cattle production cycle and to segregate the causes and effects of the cycle so that the influences of demand and supply upon the cycle could be more clearly defined. The objective of the analysis of the cattle production cycle was to determine whether the cycle or factors relating to it could be employed in predictions of value to livestock producers in the beef cattle industry.

The underlying methods followed in the analysis in this study were deductions from graphical presentations of factors affecting the cycle and the comparison of these factors by means of multiple correlations to determine their relationships.

Limitations in analysis resulted from the difficulty in obtaining comparable data in comparisons involving the same periods of time; the necessity of using data in analysis that at best are only good estimates of actual happenings; and the fact that data concerning the subject were limited to only one or two cycles making generalized statements for all cycles impossible.

Although beef cattle made little gain in numbers following 1900, beef production made a rather substantial increase. With a trend line as reference, beef and veal production increased approximately 36 per cent from 1900 to 1944, while during this same period beef cattle numbers decreased slightly. Factors contributing to this increase in production are: (1) increases in calf slaughter

resulting from an increase in dairy cattle numbers; (2) improved management practices reducing losses of both calves and older stock; (3) increase in number of births per thousand cattle; (4) production of mature cattle ready for market at an earlier age than previously thus permitting an increase in the number of cows and heifers held back in herds and making it possible to produce and market a larger number of beef animals each year.

Beef cattle per one hundred human population decreased from 71.4 cattle in 1890 to 39.6 cattle in 1944, a reduction of 44.5 per cent. During this same period milk cow numbers kept pace with increases in human population maintaining a rather constant ratio of around 20 cows for every 100 of human population.

The lengths and amplitudes of the expansion phases in the cycles studied were much more regular then those of the contraction phases. For this reason the expansion phases were more adaptable to predictions. There was no definite regularity in the yearly percentage changes in cattle numbers in either the expansion or liquidation phases of the four cycles studied.

Although the percentage of the various classes of cattle slaughtered serves as an indication of the phase of the cattle production cycle, the fact that data on cow and heifer slaughter include both beef and dairy cattle, makes it impossible to predict with any degree of accuracy what changes in numbers are due to beef cattle operations and what changes are due to dairy cattle operations.

Since cattle slaughter usually progresses at a high rate after the peak in numbers has been reached, if the monthly com-

position of farm herds were known, a reasonable estimate of production activity could be made. Such information could be used advantageously by cattle producers interested in knowing the seasons of the year when different classes of cattle are being sent to market and in checking estimates of livestock production.

Retail price of beef and national per capita income were found to have a high correlation coefficient of .849 with a probability of less than one per cent. An equally high correlation coefficient (.8015) with a probability of less than one per cent was obtained for national per capita income and beef steer prices. Both correlations point toward the supposition that national per capita income is one of the major factors affecting the level of cattle prices. An estimate of the trend in future prices could be obtained by observing the trend of national per capita income.

With no time lag between yearly slaughter (production) and average yearly beef prices, there appears to be no significant correlation. A significant negative correlation exists for a two-year lag between production and price accountable by the fact that a high price results in large profits which stimulates production activities and decreases slaughter by the holding back of breeding stock. A low price results in unfavorable profits, which, if they persist, lead to increased marketings.

Peaks in purchasing power figures came at a time when cattle slaughter (supply) was at its low point. Producers respond to a high purchasing power by expanding their breeding herds. This action results in a temporary reduction of marketings.

Purchasing power of beef cattle passes through cycles similar

to those of beef cattle numbers. The peaks in the purchasing power cycles did not occur until several years after the low points in the production cycles had been reached. This condition is apparently the reaction of producers to profits.

Producers tend to respond to present purchasing power by expanding or limiting their production policies accordingly; i.e. when purchasing power is high, marketings are low because breeding activities are in full-swing; and when the purchasing power is low, marketings are high, because liquidation is taking place.

Useful data may be obtained in following the movements of the beef cattle production cycle. Changes in the composition of total cattle numbers and yearly cattle slaughter are reported by the various state and federal agricultural agencies. Changes in the classes of cattle slaughtered under federal inspection, which gives an indication of breeding activities, are published by the United States Department of Agriculture. Federal publications report national per capita income which can serve to indicate the future level of cattle prices. Cattle producers can plan more intelligently their livestock programs with these types of information.

ACKNOWLEDGMENTS

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